A General

TREATISE

OF

Artillery:

OR, GREAT

ORDNANCE.

Writ in *Italian* by *Tomaſo Moretii* of *Breſcia*.

Ingenier firſt to the Emperour, and now to the moſt Serene Republick of *Venice*.

Tranſlated into *Engliſh*, with Notes thereupon, and ſome Additions out of *French* for Sea-Gunners.

By Sir *JONAS MOORE*, Kt.

With an *Appendix* of Artificial Fire-works for War and Delight; by Sir *Abraham Dager* Kt. Ingenier.

Illuſtrated with divers Cuts.

LONDON,
Printed by *A. G.* and *F. P.* for *Obadiah Blagrave* at the *Bear* in St. *Pauls-Church-Yard*. 1683.

THE AUTHOR TO THE Courteous Reader.

IN the continual and laborious Service, for the ſpace of five and twenty years (in which time, I have always exercis'd the Charge of an Engineer, as well in the Wars of Germany, Dalmatia, *and in the Defence of* Candia:) *Amongſt other my Military Obſervations, I have always much admired, the excellent Invention and prodigious Effects of Great Artillery. Of which having Compoſed a ſmall Treatiſe for my own Uſe, which coming accidentally into the hands of my Friends, and being by them diſperſed in Manuſcripts into moſt Cities of* Italy, *I have at laſt by their importunities, and eſpecially the earneſt ſollicitation of my*

worthy Brother, and famous Mathematician, Doctor Segnior Andrea, *permitted it to be publiſhed for the Uſe and Benefit of thoſe who are curious in Artillery. Being a Sacrifice which I make, not to Ambition, but for the Friendſhip and Utility of Souldiers. Some, perhaps, have done better, but have inlarged ſo much for Ornament and Elegancy, that they have made their Volumes almoſt as heavy, as the Artillery of which they Treat.*

I therefore have writ that which I judge ſufficient for the knowledge of a Souldier, and as ſuccinct as poſſibly I could, being not willing to be tedious in things leſs neceſſary. As for me, I never was to ſee the Artillery in China; *but in this Part of the World, in which I have practiſed, I have not been wanting to ſee and examin, as much as could be, the beſt Proportions and Operations; And have always ſought after the Acquaintance, Practice, Advice, and Directions of the Eminent Profeſſors in this Art, and have read moſt of thoſe Books which have been written of this Subject.*

Accept

to the Reader.

Accept this my Military Fatigue, and if you find any oppoſition, or that in any part I have not been ſufficiently plain, I pray you come to me, whilſt I am yet living, and you ſhall receive all ſatiſfaction.

Vivi Felice.

This

This Treatiſe is divided into Five Parts:

The
1. Treateth *Of Things General to all Artillery.*
2. *Of Forming the Bore or Chaſe.*
3. *Of Carriages.*
4. *Of the Charge of Powder and Shot.*
5. *Of Shooting in Great Artillery.*

An Appendix:

Of the Petard.

THE

done before.

Axis	Perife-ries.	Diff.	Axis	Perife-ries.	Diff.
1	2.0000		50	2.4218	
		12			124
1	2.0012		51	2.4342	
		16			125
2	2.0028		52	2.4467	
		20			127
3	2.0048		53	2.4594	
		26			129
4	2.0072		54	2.4723	
		28			129
5	2.0100		55	2.4852	
		33			131
6	2.0133		56	2.4983	
		37			131
7	2.0170		57	2.5114	
		43			131
8	2.0213		58	2.5245	
		48			132
9	2.0261		59	2.5377	
		53			133
10	2.0314		60	2.5510	
		56			134
11	2.0370		61	2.5644	
		62			135
12	2.0432		62	2.5779	
		64			136
13	2.0496		63	2.5915	
		68			137
14	2.0564		64	2.6052	
		70			137
15	2.0634		65	2.6189	
		74			138
16	2.0708		66	2.6327	
		76			138
17	2.0784		67	2.6465	
		78			139
18	2.0862		68	2.6604	
		80			140
19	2.0942		69	2.6744	
		82			140
20	2.1024		70	2.6884	
		82			141
21	2.1106		71	2.7025	
		86			141
22	2.1192		72	2.7166	
		89			143
23	2.1281		73	2.7309	
		92			144
24	2.1373		74	2.7453	
		94			146
25	2.1467		75	2.7599	
		94			146
26	2.1561		76	2.7745	
		97			146
27	2.1658		77	2.7891	
		98			147
28	2.1756		78	2.8038	
		100			148
29	2.1856		79	2.8186	
		100			148
30	2.1956		80	2.8334	
		101			148
31	2.2057		81	2.8482	
		103			148
32	2.2160		82	2.8630	
		104			149
33	2.2264		83	2.8779	
		104			150
34	2.2368		84	2.8929	
		106			150
35	2.2474		85	2.9080	
		107			151
36	2.2581		86	2.9231	
		111			151
37	2.2692		87	2.9382	
		111			152
38	2.2803		88	2.9534	
		112			152
39	2.2915		89	2.9686	
		113			153
40	2.3028		90	2.9839	
		114			154
41	2.3142		91	2.9993	
		114			154
42	2.3256		92	3.0147	
		115			155
43	2.3371		93	3.0302	
		117			156
44	2.3488		94	3.0458	
		119			156
45	2.3607		95	3.0614	
		119			157
46	2.3726		96	3.0771	
		122			157

Example I.

WHere the longer *Axis* of the Elleipſis is 1 and the ſhorter .78; Becauſe the Table is made for ſuch Elleips's, enter with .78, the Perifery of that Elleipſis will be 2.3038.

Example II.

The longer *Axis* 1, the ſhorter .4382, I enter with .4 gives 2.3371: Then to find the part anſwering to .71, ſay, If 100 give .117; what ſhall .71 give? Anſw. .83, which added to 2.3371, gives 2.3454 for the Perifery deſired.

Example III.

Where the longer *Axis* is 388, the ſhorter 280, firſt ſay, 388 : 280 :: 1.000 : Anſw. .721, ſeek in the Table for .72, it gives 2.7166; then ſay, 1.0000 : 2.7166 :: 388 : Anſw. 1054.06, which is the Circumference deſired.

Example IV.

The longer Diameter 32.54, the ſhorter 18.64; ſay; 32.54 : 18.64 :: 1.000 : 572; to which in the Table anſwers 2.5114, and the part proportional for 2 is 26, which makes the whole 2.5140; then 1.000 : 2.5140 :: 32.54 : 81.805 the Perifery required. The Area or Superficies of an Elleipſis is eaſily got by this Rule. As the longer Diameter, is to the ſhorter: So is the Circle of the longer Diameter, to the Elleipſis.

I have made above 45000 *Arithmetical Operations* for this *Table*, and am now well pleaſed it is finiſhed. Some perhaps may find ſhorter ways, as I believed I had my ſelf, 'till adviſed otherwiſe by the truly *Honourable the Lord BRUNCKER.* I therefore purſued the Rules given by me, in that *Contemplation of the Elleipſis* Printed in my *Arithmetick*, taking 100 Elleipſis betwixt that which falls upon the *Diameter* equal in this caſe to 2.0000 the firſt in the Table, and the greateſt which is the Circle

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THE

An Excellent TABLE *for the finding the* Periferies *or* Circumferences *of Elleipſes or* Ovals, *ſo near the Truth as any Mechanical Practice can requir Calculated with great Diligence and Care by Sir* JONAS MOORE, *and n done before.*

Axis	Perife-ries.	Diff.	Axis	Perife-ries.	Diff.
1	2.0000		50	2.4218	
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46	2.3726	122	96	3.0771	157
47	2.3848	122	97	3.0928	158
48	2.3970	124	98	3.1086	158
49	2.4094	124	99	3.1244	158
50	2.4218		⊙	3.1402	

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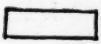
SOLI DEO GLORIA.

[illegible]

A Definition of Geometry.

A Point, is that which hath no party.

A Line, is a length without breadth.

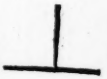


A Superfice is that which hath length and broadneſs only.

A Body is that which hath length, breadth, and depth.

A ſtraight Line, is equally extended within its points.

An Oblique Line bended, is unequally comprehended within its points.

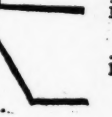


A perpendicular line, is that which falling upon another makes the ſtraight Angles, which are of 90 degrees.

Parallel Lines, are thoſe which are equal every where diſtant within themſelves.

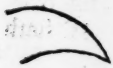
Angle, is the inclination of two lines a point.

A ſtraight Angle, is that whereof the ſides are perpendicular, and is of 90 degrees.

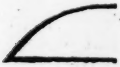


An Angle Obtuſe, is that which is bigger then a ſtraight one.

A Sharp Angle, is that which is leſs than a ſtraight one.

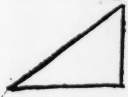


An Angle of bended Lines.



An Angle Mixt.

A Triangle, is a Superfice compoſed of three Lines.



A Rectangle, is that which hath a ſtraight Angle.

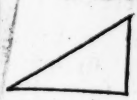
An Ambligone Triangle, is that which hath an Angle Obtuſe.

An Oxigone Triangle, is that whereof three Angles are ſharp.

An Equilateral Triangle, is that whereof the three ſides are equal.

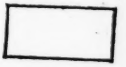
An Iſoſcelle Triangle, is that whereof the two ſides are equal.

A Definition of Geometry.



A Scalene Triangle, is that whereof three ſides are unequal.

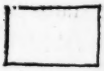
A Quadrilateral, is a figure of four equal ſides, and of four ſtraight Angles



A long Square, is that which hath the four Angles ſtraight, and not the four ſides equal.

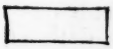
A Rombe, is that which hath the four ſides equal, and not the four Angles ſtraight.

A Romboide, hath the Angles and the ſides equal oppoſite, without being equilateral or rectangle.



A Parallelogram, hath the ſides oppoſite Parallels as the four Precedent Figures.

A Trapeze, is a figure whereof all or ſome ſides are unequal.



Regular Superfice.

Irregular Superfice.

Bended

A Definition of Geometry.

Bended Superfice.

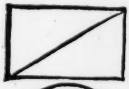
All Lines drawn from th Center to the Circumference ar equal.

Circle, is a plain figure, wher of the circumference is equally diſtant from its Center.

Center, is the point within the Circle, equally diſtant from the circumference.

A Diameter, is a ſtraight Line which paſſing by the Center hath both its extreams withi the Circumference.

A Semidiameter, is a ſtraig Line from the Center unto t Circumference.



A Diagonal, is a ſtraight Line drawn from one Angle to the other, in a figure of four ſides.

A Section or Corde, is a ſtraight Line which doth not paſs through the Center, and hath its two ends at the Circumference.

THE FIRST PART.

Of Artillery in General.

CHAP. I.

Of the Names and Deſcription of Great Guns, and of their Parts.

THis Military Engin, of which we intend to treat, came to be called *Bombarda*, Gun, Cannon, and Artillery; (whence come Gunners, Cannoneers, and Artillery-Men, being thoſe that do Mannage them;) *Bombarda*, from *Bombo*, a reſounding Noiſe, and from its ſenſible Effect, burning whilſt it is employed; *Cannone* or *Cannon*, from the likeneſs it holds with its *Canna* (Bore or Concavity) the Form or Frame being naturally long, round, and hollow in the midſt; *Artigleria*, from *(Artiglio)* the Tallons or Claws of ravenous Fowls, perhaps becauſe its Shot flying far off diſmembers and tears in pieces all that it meets; whence ſome Natures of this Machine are called *Smeriglii*, long-winged Hawks; *Falconi*,

Falconi, Falconets; *Paſſavolanti*, ſwift-flyi
Arrows.

Artillery, or Great Guns, are nothing mo
than a long round piece of Braſs or Iron bor
up, formed with Art and Proportion to offer
far off, with a Ball of Iron, Stone, or any a
tificial Subſtance, Charged with Gun powd
which is in an inſtant fired within. They w
firſt put in practice by the *Venetians* aga
the *Genoueſes* before *Chiozza*, in the Ye
1376.

a *Anima.* The *Concavity*, [a]Chaſe, Concave of th
Peece, is that hollow or empty part in whi
Fig. 1. they put the Charge, as in the *Figure* (1
A C K M.

The *Mouth* or *Muzzle*, is the extremity o
the Concave, by which you load and unload the
Peece, A S C.

The *Calibre*, is the Diameter of the Mouth,
A C.

The *Touch hole*, is that little hollow V
which paſſeth from the outward or convex
perficies of the Peece to the very Concave o
Chamber, from that end or part where the
Chaſe is incloſed, made to give fire to th
Powder within, I K.

b *Culatta.* The [b]*Breech*, is of ſolid Metal, which inclo
ſeth the Extremity of the Chaſe about th
Touch hole.

c *Codone.* The [c]*Caſcabel*, or outmoſt Pommel or Buttor
of the Breech, which ſerves for a Hand
to mannage the Artillery, R Q.

The *Trunnions*, or pieces of Metal which ſtand out of the exterior Superficies of the Gun, and placed about the middle, by which the Peece lies equally ballanced in her Carriage, and upon which it moves, G H.

The *Maniglions*, or Dolphins, after the *German* manner, are two Handles, which are placed upon the Back or uppermoſt part of the Peece near the Trunnions, and near upon the Center of Gravity of the Peece, to mount and diſmount it with eaſe, *a b.*

The *Body of the Peece*, is that part which is comprehended betwixt the Center of the Trunnions and the Caſcabel, which ought always to be more fortified than the other part, G R.

[a] *Vacant Cylinder*, is that part of the Peece which is comprehended betwixt the Center of the Trunnions and the Muzzle, G B.

[a] *Volata.*

The [b] *Frees*, or *Muzzle-Ring*, is that thick Corniſh which incompaſſeth the convex Superficies of the Peece near the Mouth, E.

[b] *Gioia della Bocca.*

The *Baſe-Ring*, or great Ring next the Touch-hole, is that thick Corniſh which binds the convex Superficies of the Peece, N R O.

The other Rings are the *Reinforced-Ring*, T; the *Trunnion-Ring*, F; and *Corniſh-Ring*, Y.

The *Line of the Cylinder*, is a direct Line, which one imagins, deſcribed along the Chaſe in the loweſt part of the concave Superficies of the Peece, which Line is parallel to the Middle of the Chaſe of the ſaid Peece, M C.

The

The *Line of Metal*, or Corniſhes, is a Line drawn above the Peece, touching both Corniſhes, N & E.

The *Diſpart Line* of the Peece, is the difference betwixt the Semidiameters of the Muzzle Ring and Baſe Ring, or a Line drawn from the utmoſt top of the Baſe-Ring, parallel to the Chaſe of the Peece, the Diſpart being the neareſt diſtance betwixt the ſame Line and the top of the Muzzle-Ring, E Z.

The *Vent* of the Peece, is the Space betwixt the Shot and the concave Superficies of the Peece, or the difference betwixt the Diameters of the Shot and Mouth of the Peece, *c d*.

The *Chamber* in all fortified Peeces, is that part of its Chaſe towards the Touch-hole equally large, nor narrower in one part than in another, foraſmuch as it receives the Powder, and a Wad or Tampion of an equal bigneſs.

a *Campana.* The [a] *Chamber* in Drakes, and old taper Peeces, is not equally large in all its parts, but narrower towards the Touch-hole.

Moſcolo, is a moveable Chamber, which one takes up and joyns to the Bore of certain *Petrieroes*, by means of the *Braga*.

Braga, in ſome *Petrieroes*, is a Ring of Iron that holds firm the *Moſcolo* or moveable Chamber to the Concavity of the Peece, and firms the Breech to the Peece.

The Names of the Parts of Carriages, and alſo the moſt uſual Inſtruments, we ſhall ſpeak of in their proper places.

CHAP

Chap. II.

Of the Mixture of Metals for Ordnance.

Artillery are very often made of Iron, eſpecially the *Petrieroes de Braga*, and other natures, which are uſed aboard Merchant-Ships; but the moſt proper and moſt uſed Metal is that called Braſs, compounded of Copper, Tin, and another part of Latten. Copper alone is too ſoft, the Tin gives it hardneſs, but too much makes it brittle; the Latten unites, and gives an alloy to the other two.

To form a Proportion of theſe Metals to make Guns of, will be various according to divers Authors.

Some to every Hundred Weight of pure Copper, give 20 lb. of Bell-Metal, or in lieu 10 lb. of ſoft Tin.

Others to every Hundred Weight of Copper give 10 lb. of Latten, and 8 lb. of ſoft Tin.

	Copper.	*Latten.*	*Tin.*
Others mix together	100	10	8
	100	10	5
	100	8	5

Others, to every 100 lb. of Copper 10, 8, or 7 lb. of Tin, without the other; and theſe two laſt are eſtimated beſt.

But the beſt and moſt proper Materials will be the Copper alone beaten. Some

Some Guns are made with their Soul or Chase covered with Brass, and then bound about with Twine, and outwardly lin'd over with Leather for Lightness. [a]

[a] *It has been found that Iron Guns, made of pure* English *Cast Iron, have proved as good as any Brass: Therefore even for some of the First Rate Ships, by consent of His Majesty, and furtherance of the Right Honourable Sir* Thomas Chicheley, *Master of the Ordnance (for the encouragement of the Manufacture) the whole Complement are Iron turned, and handsomely finished.*

Chap. III.
Of Powder.

THe Efficient Cause for Expelling the Shot, is the Fire that is made of a Powder compounded of Saltpetre, Brimstone, and Charcoal.

The Saltpetre makes the Blow or Crack, the Sulphur takes fire, and the Coal rarifies the other two, to make them fire the better.

Two sorts of Gun-powder are commonly in use; One is made of five, one, and one, being compounded of five parts of Saltpetre, one of Sulphur and the other Coal,

The other sort, being stronger, is of six, one, and one, being made of six parts of Saltpetre, one of Brimstone, and the other of Coal.

For

For Artillery, that of five, one, and one, is generally uſed, and the other for Muſquets and ſmall Arms, although ſome uſe this for Artillery, eſpecially for Field-peeces.[b]

[b] *The worſt that is made for his Majeſties uſe in* England *is of the latter, ſix, one, and one. It would be a very advantageous Experiment, that from a Barrel of Powder one could ſeparate the Petre, and know what weight was of it exactly.*

Anciently they made Powder of four, one, and one, *viz.* four parts of Salt-petre, one of Brimſtone, and one of Coal, which ſerved for the Artillery of thoſe times, being ſmaller than our modern; but this Powder being overweak, is not now in uſe.

To compare together the ſtrength of theſe three ſeverally, the Gunners have commonly a regard to the quantity of Salt-petre which is found in each; from whence they ſay that theſe will make the ſame effect. 451 of Powder of four, one, and one; 421 of five, one, and one; and 401 of ſix, one, and one, finding in all theſe weights an equal quantity of Salt-petre, *viz.* 301: and being to load an ancient Peece, it would be convenient, for example, to take 241 of Powder of four, one, and one, in lieu whereof they will imploy 221 $\frac{2}{3}$ of that of five, one, and one, or elſe 211 $\frac{1}{3}$ of that of ſix, one, and one.

Others in lieu of that of four, one, and one,

make uſe of $\frac{4}{5}$ of that of five, one, and one; and in ſtead of that of five, one, and one, imploy $\frac{1}{4}$ of that of ſix, one, and one. So in room of 30l of four, one, and one, they uſe 24l of five, one, and one; in lieu of 30l of five, one, and one, they make uſe of 22l $\frac{1}{2}$ of that of ſix, one, and one.

And although this manner is diſallowed by ſome, (notwithſtanding it is not to be contemned) becauſe an equal quantity of Salt-petre mixed with a different quantity of other materials, doth not equally operate, but is more efficacious being united with a leſs proportion of the others (even to certain proportions) than with a greater, becauſe they overcharge the virtue of the Salt-petre with their too great quantity of the other. Whence 42l of Powder of five, one and one, are ſtronger than 45l of four, one, and one; and 40l of ſix, one, and one, works a greater effect than 42l of five, one, and one, although all contain 30l of Salt-petre.

So I have ſeen and tried by experience that 40l of Powder of ſix, one, and one, doth greater effect than the whole of that of five, one, and one, *viz.* 20l more of that than 30l of the other.

How much Powder muſt be allowed to each Peece of Ordnance ſhall be ſpoken of in its proper place.

CHAP

Chap. IV.

Of Shot, and its Vent.

TO Field-peeces of the first and second kind they give Shots of Iron, but to those of the third, Stone-shot, and other Artificial Bodies not heavier than the said Ball; and to Field-pieces of the least nature Shots of Lead.

Amongst Balls of the said Diameter, but the three Natures aboveſaid, is commonly assign'd this proportion.

Iron weighs the triple more than Stone, as 3 to 1.
Lead weighs one half more than Iron, 3 to $2\frac{1}{2}$
Lead to Stone is $4\frac{1}{2}$ times more, as 9 to 2.

But to speak more properly:

Iron is to Stone, as $31\frac{1}{2}$ is to 10.
Lead to Iron, as $14\frac{1}{4}$ to 10.
Lead to Stone, as $47\frac{1}{2}$ to 10.

Nevertheleſs not all Leads, Iron, or Stone, are of the same weight.

To load Artillery with Shot, as well Iron, Lead, as Stone, they do not fill the Chaſe, but leave space for vent; for the Peece not being perfectly round, the Shot may go in and out easily. But there may not be too much vent, leſt the Fire paſs, and the Blow may come too weak.

Therefore the Diameter of a Ball being given, to have the Calibre or Diameter of the Mouth, you muſt adde its Vent; or the Calibre being given, to find the Diameter of the Ball, you muſt ſubtract the Vent.

In ſome the Vent is found, by adding to every 10 Pound of ſhot, one pound, as 30 making 33, and taking the Diameter of the Ball from 33, by the Caliper-Compaſſes giveth 30l.

Others take for every 12l, 1l, *viz.* one Ounce in the Pound[a], and makes the ſame thing.

[a] *All* Italy *over*, 12 *Ounces makes a Pound.*

But the uſual Rule is to make the Vent always the one and twentieth part of the Diameter of the Ball, or $\frac{1}{21}$ of the Diameter of the Mouth or Muzzle.

Some are of opinion, that to make a Gun bear a certain Load of Ball, one make it juſt its Calibre, according to the Diameter of the Ball of which it weighs, but then they work with a leſſer Ball: yet if one would make a Culvering from 30l, they take the juſt Diameter of 30l, then in action they uſe a Ball with the Vent, which will be leſs than 30l, but it ſeems more reaſonable to make the Calibre greater to uſe the Ball of its true Weight.

The Diameter of the Shots of Iron, Stone, and Lead of all us'd Weights, is by Gunners deſcribed upon a Ruler of Braſs, of four Faces, called by them the Calibre, *viz.* upon the three Faces the Diameters of Shots of Iron, Lead, and Stone; and upon the fourth Face, the Foot divided

vided into Inches, *&c.* according to the Country.

We put here the ſaid Scale corrected and adjuſted to the *Venetian* Meaſure, unto 150l, as repreſented in the ſecond Figure.

Note, that the ſaid Scale, not holding longer Diameters than of 150l, one may yet work by greater Weights unto 1200.

The Weight being given, to find the Diameter of the Ball, divide the Number of Pounds propounded, by Eight, then the Quotient of this Diviſion being ſearched upon the Face of the Scale, will give you the Semidiameter, by redoubling of which you ſhall have the whole Diameter of the Shot required.

For Example, if 280 Pounds be given, divide this Number by Eight, the Quotient is 35, then the Diameter of 35 being taken upon the Scale, and redoubled, will give the Diameter deſired of 20l.

The Diameter of a greater Shot being given contained in the Scale, to find the Weight in Pounds, divide the ſaid Diameter in half, and applying it to the Scale, obſerving the Number to which it correſponds, which being multiplied by Eight, will give the Number of Pounds of the Ball required. [a]

[a] *Spherical Bodies, of what Metal ſoever, are one to another in weight, as the Cubes of their Diameters; therefore if the Diameter and Weight of any known Spherical Body be given, and*

and the Diameter of any other like Body be given, and the Weight sought; or the Weight given, and the Diameter be sought: say, As the Cube of the Diameter given, is to the Weight given; So is the Cube of the Diameter of the unweighed Sphere, to its Weight: and contrariwise for the Diameter. By this Rule, having the Diameter and Weight of a Shot, one may find the Weight of another; or having the Weight and Diameter of a Shot, and the Weight of another, one may find the Diameter. My Father, the 14th of March 1671, weighing several Iron Bullets with a Curious Scale, found one very near round of 6 Inches and $\frac{63}{100}$ parts, to weigh exactly 41 Pounds, which agrees exceeding neer to 9 Pound for 4 Inches; and from the aforesaid Rule, a Bullet of 1 pound Weight will have for its Diameter 1 Inch, and $\frac{23}{100}$ of an Inch. The Diameter of one pound of course Lead will be 1 Inch, and $\frac{42}{100}$ parts, and of hard Stone 2 Inches, and $\frac{17}{100}$ parts. For making the Ruler for Calibres, the Author wants a Table of Solids; *I here insert one, made long since by my Father, more exactly than those printed in* Ars magna Artillerii, *or* Furnier, *which followeth.*

The

The Table of the Line of Solids.

1	046:4	¼	148:1	½	249:0	41	344:8
2	051:5	½	151:8	16	251:9	42	347:6
3	067:6	¾	155:3	½	254:4	43	350:3
4	073:7	4	158:7	17	257:1	44	353:0
5	079:4	¼	161:9	½	259:3	45	355:6
6	084:4	½	165:0	18	262:0	46	358:3
7	088:8	¾	168:1	½	264:2	47	360:8
8	092:9	5	171:0	19	266:8	48	363:4
9	096:6	¼	173:7	½	269:3	49	365:9
(1)	100:0	½	176:5	20	271:4	50	368:3
1	103:2	¾	179:1	21	275:8	51	370:6
2	106:2	6	181:7	22	280:2	52	373:2
3	109:1	½	186:6	23	284:2	53	375:5
4	111:9	7	191:2	24	288:4	54	377:7
5	114:5	½	195:7	25	292:4	55	380:2
6	116:9	8	200:0	26	296:2	56	382:3
7	119:3	½	204:1	27	300:0	57	385:1
8	121:6	9	208:9	28	303:6	58	387:3
9	123:8	½	212:6	29	307:2	59	389:6
(2)	125:9	10	215:4	30	310:7	60	391:4
1	128:0	½	219:1	31	314:1	61	393:6
2	130:0	11	222:3	32	317:4	62	396:0
3	132:0	½	225:4	33	320:7	63	398:2
4	133:9	12	228:9	34	323:9	64	400:0
5	135:7	½	232:0	35	327:1	65	402:0
6	137:5	13	235:1	36	330:1	66	404:1
7	139:2	½	238:2	37	333:2	67	406:2
8	140:9	14	241:0	38	336:1	68	408:2
9	142:5	½	244:4	39	339:1	69	410:1
(3)	144:2	15	246:6	40	341:9	70	412:1

The Table of the Line of Solids.

71	414:3	96	458:0	
72	416:2	97	459:5	
73	418:0	98	461:1	
74	420:1	99	462:5	
75	421:7	100	464:2	
76	423:6			
77	425:3			
78	427:2			
79	429:3			
80	430:8			
81	432:7			
82	434:6			
83	436:6			
84	438:2			
85	439:6			
86	441:6			
87	443:1			
88	444:7			
89	446:6			
90	448:1			
91	449:6			
92	451:5			
93	453:1			
94	454:6			
95	456:2			

The Uſe whereof is this. By a Scale of Inches, or from any Scale leſſer or greater, which may repreſent Inches, and every 100 *part of an Inch, as that* (Fig. 2.) *take out for Example* $1\frac{22}{100}$ *for Iron,* $1\frac{62}{100}$ *for Lead, and* $2\frac{62}{100}$ *for Stone, and prick them from the beginning of the Ruler* A, *upon the ſeveral Scales of Lead, Iron, and Stone, to the figure* 1, *which ſignifies one Pound: then you muſt make three equal Diagonal Scales for every one of thoſe Diviſions* A. 1. *divided into* 100 *or* 1000, *as in the* Fig. 3, *one is done for Iron divided into* 5000 *parts. Now if you deſire for Example to divide the Scale for each pound for Iron caſt Shot, by the Diagonal Scale, and the Table of Solids, take the Numbers in the Table anſwering to the ſeveral Pounds or Parts, and from your Diagonal Scale* (Fig. 3.) *take thoſe parts, and prick them from* A *the beginning of the Scale to the place that ſhall ſignifie the Pounds anſwerable. Suppoſe it be for* 6l, *I take* 1.81 *from the Scale with the Compaſſes, and ſet it from* A *to* b 6, *and* 2.15 *for* 10l *to* c, *and ſo from one Diviſion to another 'till the Ruler be Compleat. The ſame work is to be obſerved for the Lines for Lead and Stone from their ſeveral Diagonal Scales; you may note that* 100 *from thoſe Scales is for* 11, 200 *for* 81, 300 *for* 27l, 400 *for* 64l, *and* 500 *for* 125l, *becauſe* 1. 8. 27. 64. *and* 125 *are the Cubes of* 1. 2. 3. 4. 5. *Note alſo, that the Table ſhews you the Tenths of a Pound to* 3l,

the

the Quarters to 61, and the half to 201, for the more exactneſs in the Diviſions. For the uſe of the Calibre Ruler, if the Diameter of the Bullet be known in Inches, juſt over againſt thoſe Inches and Parts is the Weight ſet in the Line, anſwering to the reſpective Metal; or contrary if the Weight be given, then the Diameter anſwers in the line of Inches. As for Example, againſt the Diameter of 4 Inches anſwers 91 of Iron, or contrary againſt 91 of Iron 4 Inches Diameter of the Bullet. But mine Author made his Scale to the Semidiameter of Bullets, which makes him take the Cube of 2, viz. 8, and to double as you ſee in the uſes of his Scale, which is far more troubleſome than this way I have ſet down.

I have added another Line to the former three, called the Line for Powder, it gives the Weight of Powder that will fill up a Cylinder, whoſe Length and Diameter are equal; it is made as the former Lines were, from this poſition (which is found by Experience) that one pound of Powder will fill a Bore or Cylinder of 3 Inches and $\frac{161}{1000}$ parts of an Inch in Diameter and Length, and the uſes are conſiderable for making Cartridges, or to know how much of the Cylinder of a Gun will be filled with a certain weight of Powder. As for Example, A Cylinder of 4 Inches and $\frac{1}{4}$ in Diameter and Length, will take $2\frac{1}{2}$ l of Powder to fill, as you may find over againſt $4\frac{1}{4}$ Inches, and over againſt 6 pounds of Powder you have $5\frac{3}{4}$ Inches

ches almoſt, for the Diameter and Length of any Bore, which I take to be very uſeful.

Chap. V.

Of the Meaſure of Artillery or Guns.

THE ordinary Meaſure to form and proportion all the parts of any Peece of Ordnance, and alſo its Carriage, is by the Diameter of the Mouth of the ſame Peece.

But to make the Ladle, Rammer, Spunge, and other Inſtruments as enters into its Chaſe, they work by the Diameter, not of the Mouth, but of the Ball of the ſame Peece. Therefore they uſe in ſome places the Foot divided into 12 Inches, and each Inch into 12 Points or Grains. We ſhall value them by Diameters, following the more ordinary way; but one may reduce all Diameters to Feet, Inches, and parts of an Inch, ſo it may be free for every one to make uſe of ſuch Meaſure as ſhall pleaſe him beſt.

Bocca or *Bore.*

CHAP.

Chap. VI.

Of the ſeveral Natures of Artillery.

ALL Artillery are commonly reduced into three ſorts. The firſt is that of the Culvering, the ſecond Cannons of Battery, the third Cannons Petrieri.

The reaſon of this Diſtinction ought to be taken from the end to which the Artillery ſerves.

The intent of Artillery in general is to offend a far off; but ſometimes is principally underſtood the diſtance of Place, ſometimes the Offence, although one never goes without the other: for being to ſhoot a far off, the Object muſt either be of a ſtrong or weak reſiſtance; but if you would offend not far off, the Object in like manner muſt be either of a weak or a ſtrong reſiſtance. Now there being four ends, it ſeems reaſonable that Artillery be reduced to four ſorts, according to the Intents for which they ſerve.

To offend a far off, in caſe of ſtrong reſiſtance, the Culverings do ſerve, which carries a Ball of Iron from 14 to 30l weight, although ſome make them to 120l.

To offend a far off, in caſe of weak reſiſtance, as in Troops, Squadrons, *&c.* thoſe Peeces do ſerve which are called Field-peeces, or the ſmall Ar-

Artillery, and not Royal, and carry an Iron ſhot from 1 pound to 10 or 12 pound.

To offend not far diſtant, in caſe of a ſtrong reſiſtance, are your Cannon of Battery, which carry a Ball of Iron from 20 to 50l weight, although ſome are made which carry to 100l and more, and ſerve to break down Walls and Parapets.

Laſtly, to offend at a ſmall diſtance, an object of weak reſiſtance, as Ships, and other Machines of Timber, they do uſe your Cannon called *Petrieroes*, becauſe they carry a Shot of Stone, or any other Artificial Subſtance, and never of Iron; and this Ball of Stone may weigh from 14l to 100l weight.

Note, that theſe are the four principal intents of each of theſe Natures, but a Peece of one ſort may ſerve in point of neceſſity for ſeveral Services.

We nevertheleſs will not diſcourſe of the common uſe, but will name three only ſorts of Artillery, reducing the firſt to *Culvering*, and *Field-peeces*, which come to one another in a neer proportion.

To the ſecond they of *Battery*.

To the third Cannon *Petrieroes*, and to which we will alſo add the *Mortars* and *Tribucchi's*, which offend by a curved Line, and moreover an Appendix of *Petars*, although improperly they are reduc'd amongſt Artillery not offending at a diſtance.

We distinguish all our great Guns in England *into two onely sorts,* viz. *Field-peeces from the least to twelve Pounders, and Cannon of Battery, from Culvering to whole Cannon.*

END OF THE FIRST PART.

To divert the Reader a little at the end of each Part, I shall give some short Discourses of the stupendeous Bridge made by that most famous Warriour Alexander *Prince of* Parma, *in the Year* 1585, *over the* Schelde *neer* Antwerp, *and of the prodigious Effect of Powder, fitted into Vessels for breaking the same. First out of* Furnier Hydro. lib. 2. *in* French.

"THE Prince of *Parma* commanding in "chief the King of *Spains* Armies in the "*Low Countreys*, and knowing of what great "concern the Recovery or the Retaking of the "City of *Antwerp* would be to his Masters "Affairs, laid Siege before it in the Month of "*August*, in the year 1584, & having seized on "several Forts and other important places about "the City, resolved to make and lay a Bridge "over the *Schelde*, at two Leagues from the "City, to hinder the Besieged from Succours "which might come from *Zealand* that way,

that

"that being the onely place by which they "could receive them. And being Maſter of the "Shore as well on that ſide of *Flanders* as *Bra-* "*bant*, he rais'd two ſtrong Bulworks on both "ſides, and then ſtruck Piles of 30, 35, 40, and "50 Foot long, and mortaſs'd them together "with ſtrong Beams and Girders to uphold a "wooden Bridge, which he called the *Palliſade*, "and upon which ten men might march in front. "The River was large in this place, 1500 pa- "ces, and ſo deep that it was impoſſible to find "Trees long and ſtrong enough to reach the "bottom; and not being able to carry on his "work more then 1000 Feet into the water, he "finiſhed the reſt, which was 1300 Feet, by 30 "Ships, which were diſtant 30 Feet the one "from the other: each Ship had two Ankers a "head, and a Stern to hinder the impetuoſity of "the Tides, and many Shipmaſts and Planks to "make the Platform of the Bridge; the Veſ- "ſels were faſten'd together with four Chains "and four Cables, and carried two Guns a "head, and two a Stern, and thirty Soldiers: "upon this Bridge one might paſs from *Bra-* "*bant* into *Flanders*.

"On the Bridge, at every 500 paces, there "were Rafts made of Shipmaſts and other "wood, to ſtop thoſe that came, and to give "leiſure to thoſe of the Bridge to fire from a- "bove and ſink them. Moreover there were "many ſmall Veſſels loaded with Soldiers, who "guarded the Avenues.

At

"At the time that they built the Bridge, the "Baſtions on both ſides the River were well "guarded with Infantry, and furniſhed with "Cannon, which nevertheleſs could not hinder "that in the ſpace of ſeven months which they "imployed in making the Palliſade, but that "many Veſſels went and came to *Antwerp*, "where they alſo fortified themſelves, and pre-"pared ſeveral Inventions to break this Bridge.

"*Frederick Junibell* or *Giambel*, Native of "*Mantoua*, an Excellent Ingeneer, who was "ſent there by the Queen of *England*, having "demanded of the Citizens three Veſſels, one "of 150 Tuns, another of 350, and a third of "500 Tuns, and 60 others wide and flat, "which he would have joyned together with "Chains, and have them diſpoſed in form of a "half Moon, to have them riſe with the Tide, "well armed with Grapnals, but he could ob-"tain but two of 70 or 100 Tuns, of which one "was called the *Fortune*, the other the *Hope*, "with ten other ſmall flat Boats.

"Then ſeeing theſe two Veſſels well timber'd, "and of a juſt capacity, he made in each, "with great ſquare pieces of white ſtone, a Cof-"fer or Cheſt of five Foot thick, 40 Foot long, "and three and a half large and deep; in one of "which he put 10000l of Cannon Powder, "and in the other 7500, and cover'd both of "them with maſſive great broad Grave-ſtones, "which might eaſily reſiſt the violence of the "Enemies Cannon.

There

"There were laid croſs theſe Machins ſeve-
"ral Matches dreſſed with Sulphur, and aboard
"each Veſſel there was an artificial Engine,
"which ought to burn a whole hour before that
"the Coffers took fire, to amuſe the Beſiegers,
"and to make them believe that there was no
"other thing then what appeared aloft.

"Beſides, there were 32 very flat bottom'd
"Shallops, full of Ingredients, of which eight
"at every half hour ought to deſcend with the
"Tide, beſides others full of wild fire, which
"were to burn leiſurely the Rafts before the
"Bridge, to the end that the Enemy being wea-
"ry by continual firing, for the ſpace of ſome
"hours, the great Veſſels might have an eaſier
"acceſs.

"The fourth day of *July* being appointed for
"this Enterpriſe, all this Preparation had not
"ſuch ſucceſs as they promiſed themſelves,
"therefore they ſuſpected ſome Treaſon; for
"theſe four Squadrons of eight Shallops apiece,
"ſet ſail almoſt all in the ſame time, contrary
"to the deſign of the Ingeneer, the tide begin-
"ning to ſlack, and the two great Veſſels going
"away ſooner than they ſhould have done, one
"ran aſhore, and wanting water, did no Exe-
"cution then kill ſome Soldiers. The Prince of
"*Parma* believing that the reſt would work
"no other effect, and that all would vaniſh in
"ſmoak, retired into St. *Maries* Fort. But a
"little after, three Shallops having burned ſome
"Rafts, and the great Veſſel as it happen'd (ſe-

"veral of the Beſiegers being come to view the "Shallops) arriving juſt upon the point of the "Palliſade, fired with ſuch violence and fury, "that it tore in a thouſand pieces ſix of the "Ships of the Bridge, overſet and blew into the "air ſeveral others, tumbled down the Prince of "*Parma*, and the Marquiſs of *Peſcara*, (who "were returning with as many men as they "could find within a league about,) made an "Earthquake four miles round, and broke the "the Glaſs windows at ſix leagues diſtance, "kill'd more than 500 perſons, amongſt whom "were the Marquiſs of *Rubais*, and the Lord "of *Billy*; moreover, emptied the very chan-"nel of the River, that being dry, and the water "rais'd in the Air, and falling in the neighbou-"ring fields, almoſt entirely fill'd with water "an adjacent Fort, and the Soldiers in the field "were up to the knees in water, had their "Cloths, Matches, Muſquets, and Artillery all "wet, and were rendred ſo unfit for ſervice, "that they had been without queſtion routed, "if the *Antwerpians* had been in readineſs to "have made a briſk Sally. The Prince forth-"with repaired this dammage, and left an open "place in the Bridge to let all ſuch like Veſſels "paſs, if they ſhould make any more attempt. "Once more thoſe of *Antwerp* ſent another "Ship of vaſt greatneſs, with hopes to perform "more advantageous effects, and called her the "*End of the War*, but ſucceeding very ill, as ſome others which were ſent down in the ſame

time

"time againſt the Bridge the 22 of the ſame "month, at laſt they were forced to render "themſelves the 17. *Auguſt*, 1583. This rela-"tion was drawn out of the Annals of *Bertius*, "and of *P. Orlandin* of the Campaigne of *Jeſus*.

THE SECOND PART:

Of the Bore or Chase of Guns.

CHAP. I.

Of the general Proportion of the Bores of Guns.

A *Great Gun* or Cannon, is a long Barrel, round and hollow in the middle. Before they are cast, they are drawn out in Design, with their Proportions.

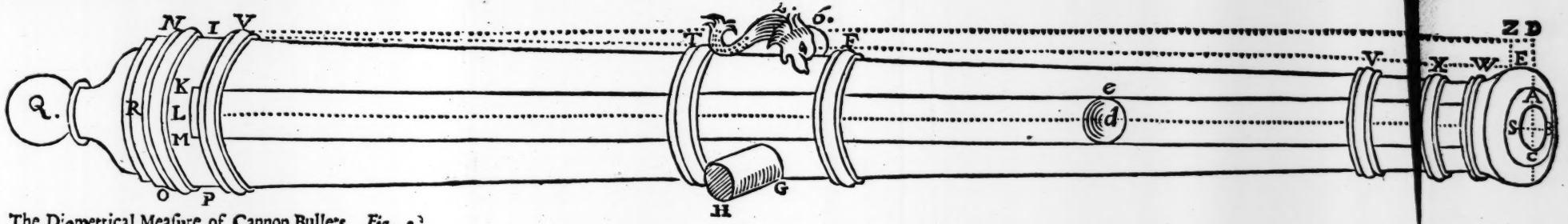
The *Proportions*, are either general or particular.

The General Proportions, are those which serve in all sorts of Ordnance, and those are, as touching their *Breech*, *Touch-hole*, *Alteration* of the *thickness*, *Trunnions*, the *Cascabel*, and *Rings*.

The Particular Proportions, are those which change according to the Nature and Species of the Artillery, as the *Calibre*, *length*, and *thickness*.

As to the General Proportions, the *Breech* is always thick, when the Metal at the Touch-hole is thick, comprehending also the Metal of the Chamber if there be any. The

Fig. 1.



The Diometrical Measure of Cannon Bullets. Fig. 2.

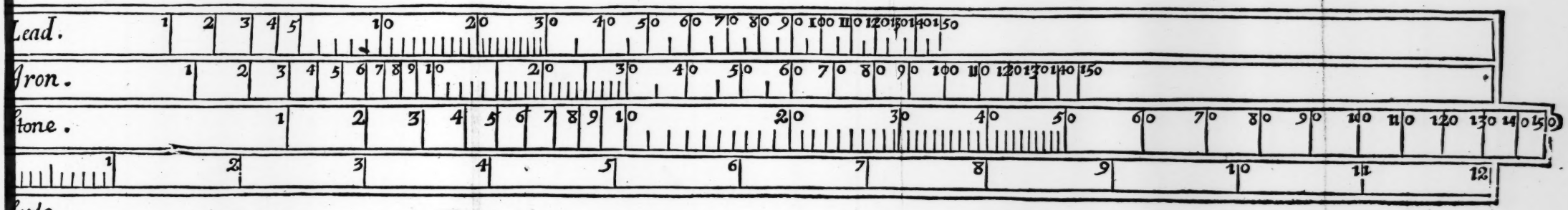


Fig. 3.

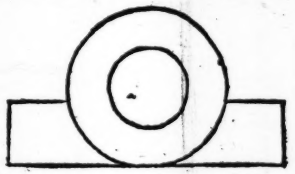
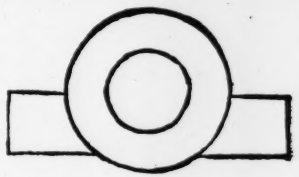
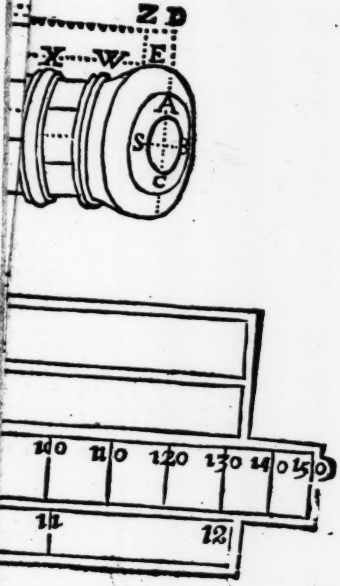


Fig. 4.




Z
D
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W
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11
12

The *Touch-hole* is uſed at the end of the Chaſe.

The *Line of Alteration* of Metals, is made at the middle of the Length, betwixt the Touch-hole and the Muzzle in caſt Ordnance.

The *Trunnions* are thick and long, one Diameter of the Chaſe or Concave (where they are made.) In Groſs Cannons very often they make them ſhorter, not finding Side-Timbers or Cheeks ſtrong enough to make the Carriages.

The *Axletree* of the Trunnions is diſtant from the Muzzle $\frac{2}{7}$ of the length of the Chaſe, and from the Touch-hole $\frac{1}{7}$, to the intent that the Peece may be moved eaſily, and being ſomething heavier behind than before, is not Muzzle heavy. Some by putting them far diſtant from the Muzzle $\frac{1}{3}$, and from the Touch-hole $\frac{2}{3}$, by which they are made too heavy at the Muzzle.

They are placed before the Level of the Metal under the Chaſe, that the Peece may be the higher mounted upon his Carriage, and may receive more degrees of Elevation. Some oftentimes place them not ſo low, but make them ſo, that their higheſt Line correſponds and paſſes by the Diameter of the Chaſe, and the Diameter of the Trunnions, by the loweſt line of Cylinder, as do demonſtrate the *Fig.* 3. and 4. Fig. III. *and* IV.

Caſcabel or *Pummel* ſerves to elevate and to direct the Cannon, and is leſſer but longer than the Trunnions.

The *Maniglions* or *Dolphins*, are two great Corniſhes at the Extremities, which riſe higher

than the Inequalities of the Rings which are upon the back of the Peece, and do not hinder the ſight, and alſo ſerve for Ornament and Strength. The Muzzle-ring is high $\frac{1}{8}$, and the Baſe-ring is high $\frac{1}{8}$ part of the Calibre about, but the Rings in Petrieroes at the Mouth are $\frac{1}{6}$, and at the Breech $\frac{1}{12}$, and are large at pleaſure.

Of the Particular proportions, we ſhall ſpeak of them underneath, according to all the natures of Ordnance.

Chap. II.

Of the Culvering.

Culverings are Diſtinguiſhed into three manners; firſt, according to the Calibre or nature of the Ball; ſecondly, as to thickneſs of the Metall; thirdly, according to the length of the Bore.

As to the Calibre, they are called *whole Culvering*, *Culvering*, and *Demi-Culvering*.

The whole Culvering are called anciently *Dragon-Drakes*, and carry a Ball of Iron from 40, 50, to 60l *&c.*

The Culvering from 35l, 30, 25, 20.

The Half Culvering from 18, 16, and 14.

As to the thickneſs of Metal, ſome are called *ſmall*, ſome *common*, other *reinforced* or *fortified*.

The Small, uſed in old time, have their Metal thick

At the Touch-hole, In the Middle, At the Neck } $\frac{7}{8}$, $\frac{6}{8}$, $\frac{4}{8}$ of their Calibre.

The Common Modern have their Metal thick

At the Touch-hole, Middle, At the Neck } 1, $\frac{7}{8}$, $\frac{4}{8}$ of their Calibre.

The Modern Fortified

At the Touch-hole, Middle, Neck } $1\frac{1}{8}$, $\frac{7}{8}$, $\frac{3}{8}$ of their Calibre.

The Culvering does not grow equally small from the Touch-hole to the Neck, but fall off at several Rings for better Fortification.

Some make the Demi-Culvering better fortified than the Culvering, as one may observe in Field-peeces, but it is not generally used.

As to the Length, they distinguish the Culvering into *ordinary*, *extraordinary*, and *bastard*.

The Ordinary Culvering, are long from the Touch-hole to the Muzzle 32 Calibres.

The Extraordinary are longer than the Ordinary, *viz.* to 39, 40, 41 Calibres.

The Bastard are shorter than the Ordinary, *viz.* onely 28, 27, and 26.

Although the true measure of the Ordinary be 32 Calibres, notwithstanding they are sometimes made of 30 and 33 Calibres, and are called Ordinary.

The Whole Culvering are made one Diameter or two less, and the Demi-Culvering one longer than the Culvering.

Of the ſeveral natures of Culvering, one may form nine *ſpecies* of each. As *Culvering ordinary ſmall*, and *Baſtard ordinary ſmall*, *extraordinary ſmall*, *Ordinary Cannon*, *Extraordinary Cannon*, *Baſtard Cannon*, *Reinforced Ordinary*, *Reinforced Extraordinary*, and *Baſtard Reinforced*.

Fig. V. One may ſay the ſelf ſame thing of the Whole and Half Culvering.

CHAP. III.

Of Field Peeces.

Field Peeces are generally reduced into the ſame Natures as Culvering, and are alſo diſtinguiſhed into three manners: 1. as to the *Calibre*, 2. as to the *richneſs* of the *Metal*, and 3. to the *Length*.

As to the Calibre, they have theſe principal natures following.

The Smeriglio or Rabinet carries a Ball of Iron from $\frac{1}{2}$l to a Pound.

The Falconet from 2, 3, to 4l.

The Falcon or half Saker, from 5, 6, to 7l.

The Saker or $\frac{1}{4}$ Culvering from 8, 10, to 12l.

Others with the ſame Calibre as theſe, will carry as before.

As to the *Richneſs* of the *Metal*, they have the ſame diſtinctions that the leſſer Culverings have, Common and Reinforced, although theſe

Field-

Field-peeces are generally uſed Fortified, and the leſſer they are the more Fortified, to reſiſt better the Force of the Powder in their frequent Diſcharges.

The *Thickneſs of Metal* at the Touch-hole, Neck, *&c.* are the ſame as the Culvering.

As to the Length, they are diſtinguiſhed into Ordinary, Extraordinary, and Common.

The *Ordinary* ought to follow the ſame Rule as the Culverings of 32 Calibre, oftentimes they are made longer, *viz.* from 32 to 34. The Saker, Rabinet, and Falconet, from 38, to 40, and 42, becauſe the ſmalneſs of their Bore, if made 32, they would not advance beyond the Circumference of their Wheels, and therefore would do no effect.

The *Extraordinary*, are thoſe that paſs the ſaid meaſure, and amongſt thoſe is remarkable the *Paſſavolante* or *Zabratana*, long from 48 to 50 Calibres, and moſt rich in Metal, and which carries a Ball from 5 to 6 pound, as the Falcon, but now are ſeldom caſt.

The *Baſtard*, are thoſe who do not arrive to 32 Calibres; amongſt which are found the *Moyenne* or Minion, which is a Modern Peece Fortified, and carries a Ball of 8 or 10 ſhot (as the Saker,) but is long onely 26 Diameters, uſed in the Gallies, being ſo ſhort for the ſmalneſs of the place.

The *Aſpide* is an ancient Peece, and poor in Metal, and although it carries 8 or 10 pound ſhot, is no longer than 22 or 20 Calibres.

The

The Muſquet *di Givoco*, is a ſmall Peece uſed onely by the *Venetian* Gunners, carrying one Pound Ball of Iron as the Smeriglio, long 28 Diameters or 30, thick at the Touch-hole Diameters $1\frac{1}{16}$, at the Neck $\frac{1}{8}$.

The *Saltamartino*, is a ſmall Peece uſed by the ſaid *Venetians*, long 15 Diameters, carries ſhot 4l of Iron as the Falconet, thick at the Touch-hole one Calibre, at the Neck $\frac{1}{2}$. Diameter. It is called the *Saltamartino*, from being turned about upon all occaſions, and being loaded behind at the Tale of the Carriage, without drawing back the Peece, and there be many of them in the ſaid State.

[a] *Ribadocchino.*

The [a] *Rabbonett*, was a Peece of Artillery anciently uſed, and carried a Pound ſhot or $1\frac{1}{2}$ of Iron as the Smeriglio, but this Rabbonett is uſed in *Flanders*, and carries as aboveſaid, and long Ordinary 36 Diameters.

Fig. V. There be other particular Names for Field-Peeces, but theſe be the moſt uſual.

Chap. IV.

Of Cannons of Battery.

THE *Cannons of Battery*, are Peeces ordinarily ſhorter than Culverings, and are diſtinguiſhed, firſt, as to their Calibre; ſecondly, as to the Richneſs of their Metal; and thirdly, as to their Length.

The

The *Calibres* are as followeth.

The ¼ *Cannon* carries a Ball of Iron from 16 to 18 pounds.

The *Demi-Cannon* from 20 to 28l.

The *Cannon* from 30, 40, 45, to 50l, and formerly even to 60 pound.

The *whole Cannon* from 70 to 120.

The Cannon *Baſilisk* from 130 to 150 and 200 pound Ball, uſed by the *Turks*.

As to the Richneſs of their Metal, ſome are Ancient and Small, others Modern and Common, and Modern Fortified.

The Ancient are ſmall, Tapered or Bell-bored.

The Chambred have their Metal thick at the Touch-hole ⅝, in the middle ⅛, and at the Neck of their Calibre.

The Tapered are thick as the Chambred, but are more Tapered towards the Touch-hole, having Diameters 4, large in the beginning Diameters 1, and in the bottom Diameters ⅓, in the middle ⅙, at the Touch-hole ⅔ of the mouth.

The Common are either Chambred, or Tapered.

The Chambred have this thickneſs of Metal at the Touch-hole ⅞, in the Middle ⅛, in the Neck ⅛.

The Incamerated have the ſame thickneſs as the former, and moreover the Chamber neer the Breech long 4 Diameters of the Peece about, large as much in the beginning as in the end ⅙, and with the [a]*Gengiva* or degrees one over

a *riſalto.*

over another, thick $\frac{1}{2}$ of the Calibre.

The Modern Inforced are all Chambred, and have such thickness at the Touch-hole one Diameter, at the Middle 5 or $\frac{5}{8}$, at the Neck $\frac{3}{8}$.

Note, first, that some are called *Inforced*, although Common Incamerated.

Secondly, observe that the quarter, and Modern half Cannon, have the Reinforcement of Fortification of a Culvering, the better to serve in its place.

Thirdly, that the Cannon *Basilisk* hath greater Reinforcement, as we shall hereafter declare.

As to the Length, they are Ordinary, Extraordinary, or Bastard.

The length of the Ordinary is 18 Diameters. Although very often they make the Demi-Cannon 22 and 24 Diameters.

The *quarter-Cannon* is made long 26 Diameters, or 28, to the end being so long, and Fortified or Reinforced, they may serve in place of Culvering or Demi-Culvering.

The length of these Extraordinary Peeces is greater than the Ordinary respectively, and amongst the rest is famous the Cannon *Basilisk* used by the *Turks* in nature of a whole Cannon, which is long from 24 to 30 diameters thick at the Touch-hole diameters $1\frac{1}{2}$, at the Middle diameter 1, at the Neck diameter $\frac{1}{2}$, and carries, as we have said, a Ball from 130 to 150 and 200l weight.

The *Bastard Cannon* are those which are shorter

ſhorter than the Ordinary ; if they are Cannons or Whole Cannons, their Calibre is 24, or 22 if they are Demi-Cannons ; 28 or 26 if they be Quatter-Cannons.

They are called *Rebuffi*, *Crepanti*, *Verrati*, long Diameters 15 ; and the *Saltamarino* may be reduced to this nature as to the length, but by us placed amongſt the Field Peeces, by reaſon of the ſmalneſs of its Calibre. Some call thoſe *Baſtard Cannon*, which have a greater length than the Ordinary Cannon, which do not arrive to the ordinary length of Culvering ; but theſe ought rather to be called either *Extraordinary Cannon* or *Baſtard Culvering*. Fig. VI.

Chap. V.

Of Cannon Petrieroes.

THE *Petrieroes*, are ſo called from its Ball of (*Pietra*) ſtone, with which they are loaded from 2 to 100 and 150 l, for the moſt and all are Incamerated, or Chambred and continued in one Peece ; or elſe with the Chamber ſeparated with a *Braga* of Iron, and therefore are called from that [a] *Braga*.

Thoſe that are continued, and of one Peece, are either Antient, or Modern.

They are long from 8, 8½ to 9 [b] diameters, although ſome are to 10 and 12.

The Antient have this thickneſs of Metal, the Chamber

a *Petrieroes a Braga.*

b *Diameter, Calibre, Bocca, Bore, Mouth*, all one, and B ſignifieth them all.

Chamber being not computed, at the Touch-hole $\frac{1}{3}$, at the Middle $\frac{1}{4}$, at the Neck $\frac{1}{6}$ of the Calibre.

The Chamber hath the *Gengiva* or rising $\frac{1}{6}$ o the Calibre, the largness is $\frac{2}{3}$, the length is D. $1\frac{1}{2}$ of the Calibre, or else diameters $4\frac{1}{2}$ of the same Chamber. The Modern have the thickness of the Metal rising at the Chamber; at the Touch-hole $\frac{1}{4}$, Middle $\frac{1}{4}$, and at the Neck $\frac{1}{6}$.

The *Gengiva*, or rising of the Chamber, is thick diameters $\frac{1}{4}$.

The mouth of the same is $\frac{1}{2}$ of the Calibre.

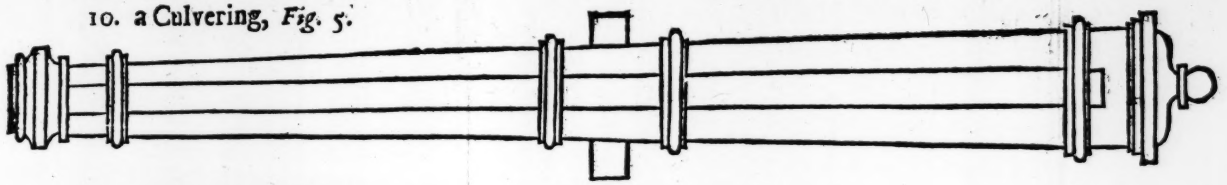
The Length is Calib. 2, *viz.* Dia. 4 and 6 of the Chamber.

But it is to be observed, that some make them Incamerated, that the Mouth of the Chamber be $\frac{1}{5}$ of the Calibre, and three times as long as large.

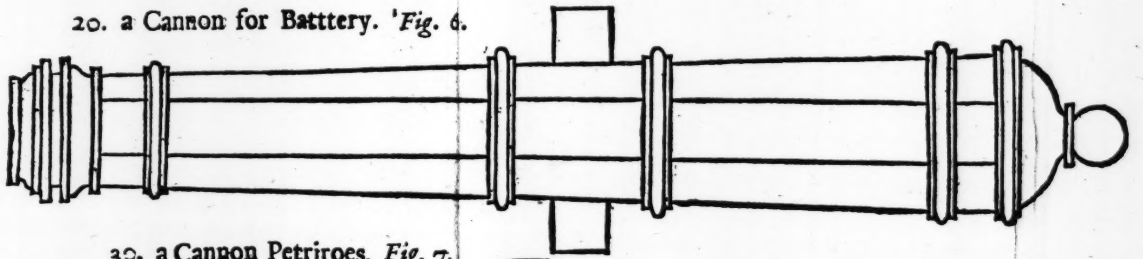
Some make the Chamber so, that it may be the $\frac{1}{7}$ of the weight of the Ball; as if the Peece carry 30l, they make the Mouth of the Chamber large, as much as is the Diameter of the Ball of Stone of 6l; they make the said Chamber long diameters 2 and $\frac{4}{7}$ of the said Chamber, and make these Peeces long from 12 to 14 diameters of the same Chamber; and the thickness of the Metal of these two with the Chamber, is at the Touch-hole diameter 1, at the Middle diameter $\frac{1}{2}$, at the Neck $\frac{1}{3}$ of the Mouth of the Chamber.

Note, that some make *Petrieres* not Incamerated, long Calibres 12, and thick at the Touch-

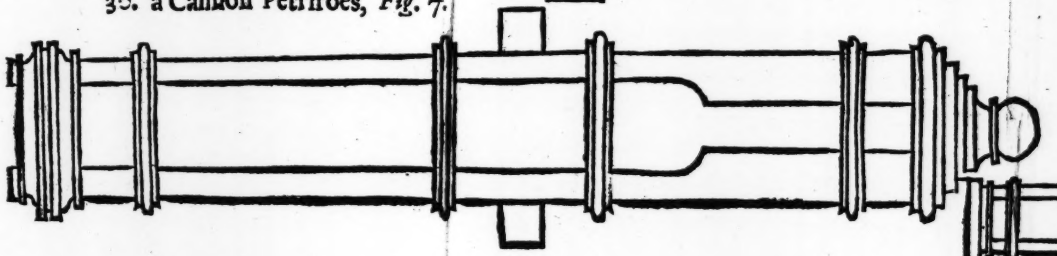
10. a Culvering, *Fig.* 5.



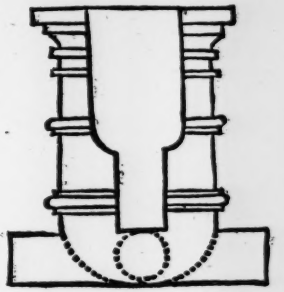
20. a Cannon for Batttery. *Fig.* 6.



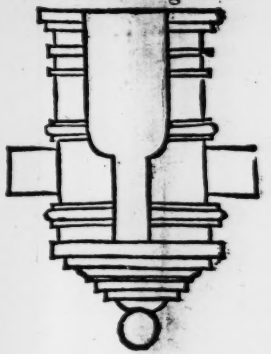
30. a Cannon Petriroes, *Fig.* 7.



Trabucchi. *Fig.* 10.

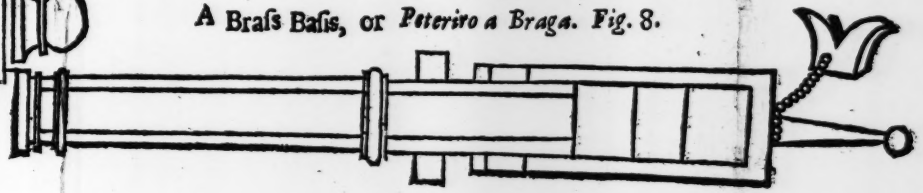


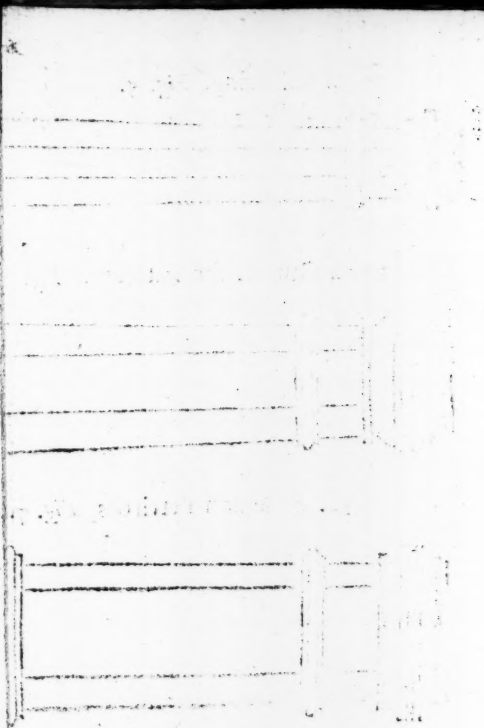
a Mortor *Fig.* 10.



a Muſcole, *Fig.* 9.

A Braſs Baſis, or *Peteriro a Braga. Fig.* 8.





touch-hole $\frac{1}{2}$, at the Middle $\frac{3}{8}$, at the Neck $\frac{1}{4}$ of the Calibre. Fig. VII.

The *Petrieroes a Braga*, have their Chamber ſeparated, which is called the *Maſcolo*, *Servitore*, and *Covetta*, and ſo they are loaded behind; they are ſerviceable upon Gallies, Veſſels, Towers, and other narrow places, where the Peece cannot reverſe; they are either of beaten Iron or Braſs, as alſo the *Servitory* or *Maſcoli*; the *Braga* is of Iron.

They carry a Ball of Stone from 2 to 14l, and no more.

They have their Chaſe long from 10 to 12 Calibres; the thickneſs behind is Calib. $\frac{1}{2}$, at the Neck $\frac{1}{4}$, or elſe behind Calibre $\frac{1}{3}$, at the Neck $\frac{1}{6}$.

The Trunnions are thick and long $\frac{1}{2}$ Calib. round about, diſtant from the Mouth $\frac{1}{4}$, and from the end $\frac{1}{4}$, about the length of the Bore.

Betwixt the Trunnions and the end in the middle, are placed two Wings, to faſten the *Braga*, and hang without $\frac{1}{3}$ of the Calibre, and are fixt to the very Axletree of the Chaſe.

For every *Petriero de Braga*, there ſhould be three *Maſcole*, which are large at the Mouth $\frac{1}{2}$, and alſo $\frac{1}{2}$ of the Bore, long in the Chaſe 4, 5, or alſo 6 diameters. The Metal about is thick one diameter, and particularly about or as much as the Peece to the Bottom, they have an Handle, and at the Head are made ſmall, to drive a little into the Bore well cloſed, *viz.* diameter round about its *Moſcolo*.

The

The *Braga* is of Iron, ordinarily fastened straight to the Wings; it is prolonged within that it may be capable of the length of the *Moscolo*, and its Coine behind, which makes it firm; and in the end hath a long trail or trail Calib. 3 or 2 with its Button, or Pummel, and serves to mannage the *Petriero*: cross the *Braga* underneath, is a place to sustain the *Mascolo*.

The Wedge is of Iron, thick $\frac{1}{3}$ or $\frac{1}{4}$ del: Calib. large at the least one Calibre, and long about. One also may have more Wedges to keep the *Mascolo* or Chamber joyned to the Bore.

Chap. VI.

Of Mortars or Trabucchi.

THey are short Peeces, of the nature of *Petrieroes*; and with these they shoot Balls of Stone, Granado-Shels, and Cases full of small Shot, not by a Right line, but by a Crooked from on high, so they fall where it should be appointed.

The Chase from the Touch-hole to the Muzzle in all, is Calib. 2 and $\frac{1}{4}$. The Chamber is long Calib. $\frac{1}{4}$, large Calib. $\frac{1}{2}$. The remainder is Calib. $1\frac{1}{2}$, the *Gengiva* or Rise of the Chamber is thick Calib. $\frac{1}{4}$. They are thick besides the Chamber at the Touch-hole $\frac{1}{4}$, in the middle $\frac{1}{4}$, at the neck $\frac{1}{6}$ of the Calibre.

There is no other difference betwixt a *Mortar* Peece and a *Trabuccho*, but in the placing of the

Trunnions, ſince the Mortar-peece hath the diameter of the Trunnions, which correſponds to the end of the Chamber. And the *Trabuccho* hath its Trunnions placed in the thickneſs of its Breech.

The Mortars or *Trabucchi*, that have their Bore long Diam. $3\frac{1}{2}$, are beſt to ſhoot Balls of Stone, Fire-balls, Baſe and Bur-ſhot, becauſe they require a greater force; but to ſhoot Granadoes they do greater effects, being long diam. 2, or a little more, by reaſon of the *Spoletta* or length of their Bore.

They are moſt uſed to ſhoot Granadoes betwixt 50 and 100l, although ſometimes one fits them to 300l weight. Fig. X.

END OF THE SECOND PART.

Concerning the Bridge, and Blow neer Antwerp, *out of* Pietro Paulo Floriani *Diffeſa & Offeſa delle Piazza. page* 141.

" BUT it did not ſo happen with *Alex-*
" *ander* Prince of *Parma*, at the Bridge
" made at the Siege of *Antwerp*, the like to
" which was never yet ſeen or related in any
" Hiſtory, being attacqued from a Machine of
" Fire, the moſt Horrible and dreadful that
" ever was put in practice in any part of the
" known World. An Engine without doubt
" invented by the proper Enemy of Mankind,
" and brought to perfection by his new Infer-
" nal Miniſters. It was eight moneths in ma-
" king by the Ingeneer of *Antwerp*, and in it
" were the only hopes to relieve the City. It
" was a great Ship ſtrongly timbred, in which
" was a ſtrong Vault or Arch made of Stone and
" Morter, filled with 200 Barrels of Powder,
" and above the Vault were great Stones of all
" forms, Cannon ſhot, Chains of Iron, enough
" to ruine a whole City. And within theſe veſ-
" ſels was laid a ſecret Fire or Fuſee ſo cunnin-
" ly, that it ſhould not fire the Powder, 'till it
" was arrived at the Bridge, or a little after, *&c.*

THE

THE THIRD PART.
Of Carriages for Artillery.

CHAP. I.
Of Carriages for Culvering.

THE *Carriages* are made of two Cheeks, four Tranſomes, or croſs beams of wood, with two Wheels, the Axle-tree, and their Iron work.

The Sides or Cheeks of the Carriage are once and a half as long as the Chaſe, which being 32 Calibres long, the Carriage will have in length 48 Calibres. Fig. XI.

Some make onely the Carriage long one and $\frac{1}{3}$ of the Chaſe or Cylinder, ſome one and $\frac{1}{5}$, but the firſt manner is moſt approved for the following reaſons.

As to the length of the Carriage, the longeſt ſuffers leſs in the ſplitting of the Peece, doth recoyl enough, but is more ſubject to break in the midſt, yet more ſpares the Wheels, is more eaſie to turn about, and mannage the Peece, and in ſhort will laſt longer. But the ſhort Carriage makes a longer Shot, doth not recoyl ſo much, and is eaſie to break it ſelf in the Breech, is good for ſmall Platforms, and upon which

Fig. XII. one gives more Elevation to the Peece.

The thickneſs of the Cheeks or Sides of the Carriages is ordinarily one Diameter of the Muzzle.

The largeneſs of the Head, to the very end of the Length, is equally from *B* 2 to *B* 4½.

The bending in of the middle from *B* 3 to *B* 3½.

The Tail from *B* 1 to *B* 2½.

The end of the Breech *B* 3 about; if at any time it turns or overſets, which happens when the Carriage is forward on the Wheel.

The Trunnion-holes are cut in the uppermoſt ſide, diſtant from the upper part *B* 3 compleat, and deep ⅔ *B*.

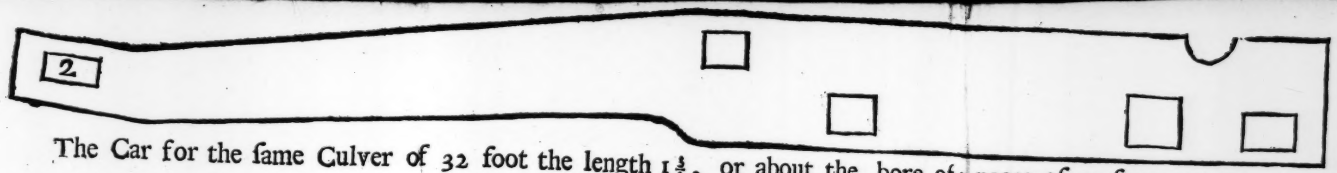
The holes for the Axletree are cut in the lowermoſt part large *B* 1½ ſquare, diſtant from the Front *B* 4 compleat, or at the leaſt *B* 3½ about, and diſtant from the uppermoſt Side *B* 2½ compleat. Some therefore do not make the Hole for the Axletree altogether ſquare,

Fig. XIII. XIV. but do make it blunt on the two inferiour Angles, as ſhews the *Fig.* 13 and 14.

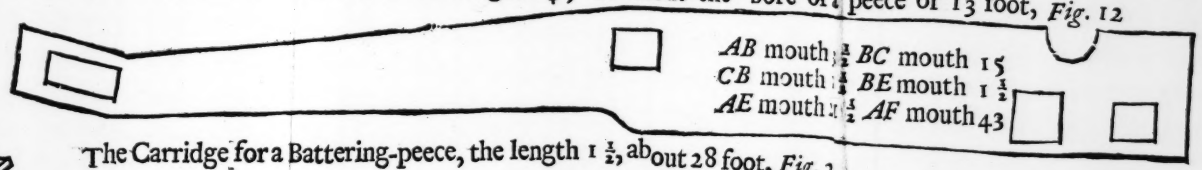
Some do not make a thorow hole for the Axletree, but only a Joynt made hollow into the lowermoſt part, when the Cheeks are not very large, and into the Joynt they place either all the thickneſs of the Axletree equally, or only

Fig. XV. XVI. ⅔ binding it with a band of Iron, which paſſeth about, as in the *Fig.* 15, 16.

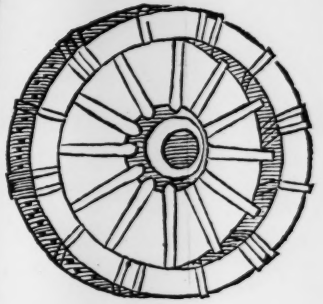
The two Cheeks or Sides of the Carriage, are faſten'd from the four Tranſomes or croſs Beams



The Car for the ſame Culver of 32 foot the length 1 ¾, or about the bore of a peece of 13 foot, *Fig.* 12

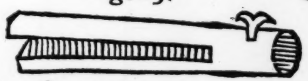


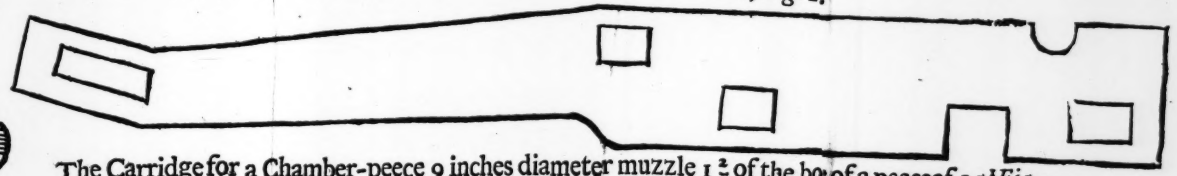
The Carriage for a Battering-peece, the length 1 ½, about 28 foot, *Fig.* 2.



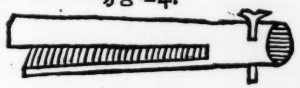
Cap ſquare, *Fig.* 20.

Fig. 23.

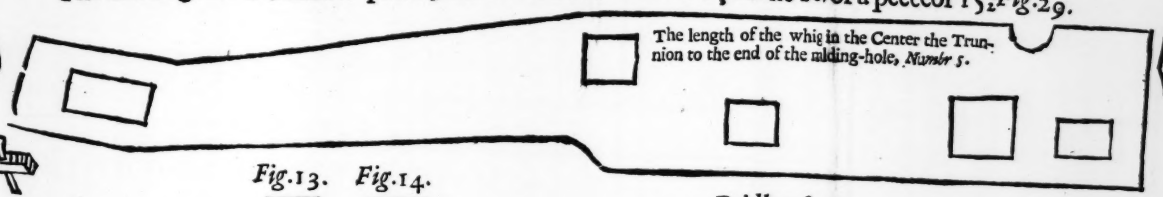




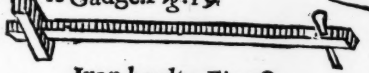
Clouts of Iron, *fig.* 24.



The Carriage for a Chamber-peece 9 inches diameter muzzle 1 ⅔ of the bore of a peece of 15 ½ *Fig.* 29.



A Gadge. *Fig.* 19.



Iron boults, *Fig.* 18.

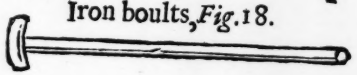
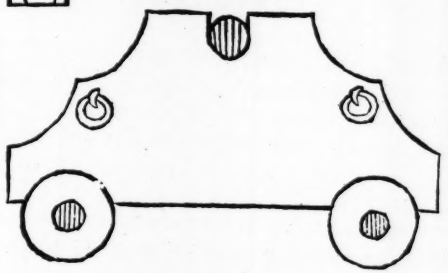


Fig. 13. *Fig.* 14.

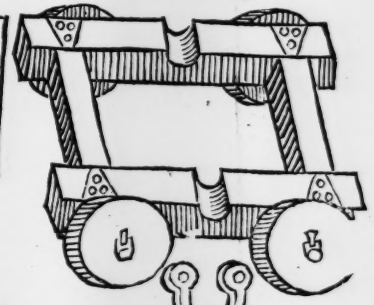
A Morter Carriage.



Bridles, *fig.* 3.

A Dowledge, *Fig.* 25.

A Ballous Carriage.



A crole-peece, *fig.* 17.

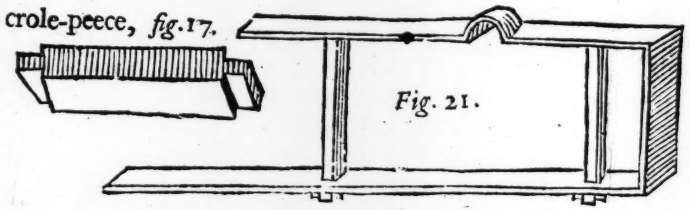


Fig. 21.

The Carriage for Petreroes, *Fig.* 30.

ge.

Beams of Wood, which beſides the general qualities of binding together the Cheeks, have alſo ſome particular.

Firſt, that towards the Mouth or Front hinders that the Peece doth not ſplit. Secondly, that of the Breech ſerves to hold up the Breech of the Culvering, and upon which it reſts. The third, that of the *Manovelle*, or little Peeces, ſerves to reſt upon, in elevating the body of the Peece. The fourth, that of the Train or Tail ſerves to place into the hole the Bolt or Faſtning-pin of the Fore-Carriage of the Peece. Fig. XVII.

All the Tranſomes are thick *B* 1, and large *B* 1 ½ (from that of the Tail except when it is large *B* 2) all equally long, *viz.* as much as the Diameter of the Peece is near the Trunnions; and moreover *B* 1, becauſe the middle Tranſome is joyned into the Sides, and ſo their Sides are parallel.

Some make the aboveſaid Tranſomes equal in length, *viz.* that of the Breech as long as the diameter of the Breech, and moreover one diameter for the Mortes, and the other for the *Manovelle* or flat Tranſome a little greater, but that of the Tail longeſt, and the Fore-Tranſome ſhorteſt of all; and the Sides or Cheeks are not parallel, but follow the unequal thickneſs of the Peece.

When the Sides of the Carriage are parallel and narrow as above, they ought to be ſomewhat taken down betwixt the Trunnions and the Tranſome of the Breech, to the end that the

body of the Peece and Corniſhes may enter within.

Beſides, ſome take down always the ſaid Sides inwardly betwixt the flat Tranſomes and the Tail-Tranſome, raiſing $\frac{1}{8}$ of a Diameter to render it more light and more eaſie to be mannaged.

The places of the Fore-locks are as followeth.

That of the Fore-part is diſtant from the Front compleatly B 1, and from the lower Side $B\frac{1}{2}$.

That of the Breech goes behind from the Trunnion-holes, as much as the Peece is long, from the Trunnions to the Breech, to the end that the Breech may lye juſt upon it, and is to lye as low as is poſſible, to give a greater Elevation to the Peece; it is to be therefore diſtant from the edge or lower ſide of the Carriage $B\frac{1}{2}$.

That of the (flat Tranſome) is higher, and diſtant from the Line of the middle Plate towards the Trunnion-holes B 1, and under the upper ſide of the Cheek $B\frac{1}{2}$.

That of the Tail, is placed in the part turned up, or over the ſame Tail, diſtant from beneath and from above of the ſide of the Cheek $B\frac{1}{2}$ and from the end B 1.

The Tranſomes do not enter with its whole piece into the Cheek, but grows ſmall above and beneath $\frac{1}{8}$ of its thickneſs.

The Iron-work neceſſary for a Carriage, are four

four Garniſhing Bolts, great Bolts or Pins of Iron, *viz.* one near every wooden Tranſome which paſſeth through the ſides of the Carriage, and may have Plate-rings and Fore-locks for to keep the Carriage ſides firm. Fig. XVIII.

In the Tail Tranſome there is a hole made, which is armed with Plates of Iron, in which is placed the Iron Pin of the Fore-Carriage, for as much as it conducteth the Artillery upon the Carriage.

Againſt the Trunnion-holes are placed a little Bolſter and Capſquare in the lowermoſt part, which doth ſhoulder or uphold the Trunnion in the recoyling, to ſave the wood of the Cheeks with his Contraforts behind. Fig. XIX.

Of late, under the Trunnions they put the Counter-trunnions or Capſquares, which is a Plate of Iron, which doth incompaſs the Trunnion-holes, and part of the upper ſide; to the end that the thickneſs of the Peece may not ſpoil it: and where they place the Counter-trunnions, there is no need of a Bolſter, although in ſome Peeces one may uſe both ways; the Counter-trunnion is ſhewed by *Fig.* 20. Fig. XX.

All the forepart is covered with a Plate of Iron, or Binding, under to the very joynting of the Axletree, and over to the Trunnion-holes faſtned with Iron nayls.

Above the Trunnion-holes paſs the Capſquares, or joynted Plates, which ſtay the Trunnions in the Trunnion-holes, and the Capſquares are faſtned by four long Capſquare-

pins, which pass through to the very bottom of the Cheek, and under are fastned with its Forelocks and Linch-pins.

Fig. XXI. One of these Capsquare-pins passeth by the Axletree to the Binding-plate below, where it is fastned with its Forelockeyes.

The Tail is also all bound over and under with its Plates fastned with Nailes, and lastly are placed two great Rings to the sides of the Cheeks, half behind the Wheels, to fasten Ropes for to mannage and conduct the Peece; and there are nayled two Hooks in the outward side of the Carriage, *viz.* one on each side near the forepart, to fasten other Cords to draw the Fig. XXII. Carriage forward on.

The Axletree of the Culvering is to be as long as to pass through the Carriage, the forepart of the Wheel with that overplus as is necessary to contain the fastning or Linchpins at the Nave, which may be 15 Diameters about.

The Thickness, for as much as the exterior largeness of the Carriage is 1 and $\frac{1}{8}$ *B*, so moreover on each side of *B* $1\frac{1}{2}$ square, and moreover that eighth part they leave; to the end that the Wheels in its motion do not touch the sides of the Carriage.

The remainer is round about the Carriage, thick in Diameter *B* $\frac{1}{2}$ or *B* $1\frac{1}{4}$, and in the end thick *B* 1.

It is made of hard wood, as of Elme, Oak, or such like.

Its Length is throughly fortified with its bar

bar of Iron which paſſeth through, of two Inches about, to the end that being ſtrong, if the Axletree ſhould break, it might alone be able to govern the weight of the Peece; it is let into the Axletree underneath.

That part which ſurmounteth the forepart of the Nave of the Wheel ſhall be *B* 1 or *B* $\frac{2}{3}$, and is defended by its clout of Iron, which is an Iron-plate that incompaſſeth the Head of the Axletree, with two Sides for to naile or faſten it to the Axletree. Fig. XXIII

The Clout of Iron hath moreover only open its Nave or forepart, and in that part which ſticks out is made a Hole which paſſeth through, as alſo in its Clout, where they put a Pin to hinder the Wheels that they do not ſlip off. Fig. XXIV

The ſame Axletree is faſtned in the Sides with a Capſquare-pin, which paſſeth through it as aboveſaid.

The Wheels for the Culvering by ſome are univerſally made high *B* 14 in Diameter, *viz.* the greatneſs of the Nave *B* 4, which is long *B* $4\frac{1}{2}$.

The length of the Spokes *B* 4 for every one, ſetting aſide that part which is joynted in, and *B* 1 for the bigneſs of the Fellows.

Some make them in Peeces of 12 to 30 high in Diameter *B* 10, but others from 30 upward 9 Diameters.

Thoſe of 10 *B* in Diameter have a more particular meaſure.

The Nave is thick *B* 3, long *B* $3\frac{1}{2}$.

The

The Spokes, long *B* 2 $\frac{1}{2}$ compleatly, but moreover have *B* 1 or *B* 1 $\frac{1}{2}$, to mortaise into the Nave and Fellows.

Those of 9 *B* in Diameter have all the Measures as is already said, but the Spokes are onely long *B* 2 compleatly, besides that part which is mortaised into the Fellows.

The Nave doth handsomly diminish to its extremity, abating from that part towards the Carriage *B* $\frac{1}{2}$, and of the other *B* 1, or little less in all.

The Spokes are 12 in number, and are fixed in the thickest part of the Nave, so that they enter *B* 1 $\frac{1}{2}$ or more; but they are placed not perpendicularly, but outwardly sloping.

The Fellows are in number six, and make up the Circumference of the Wheel, and in each of them are fixed two Spokes; the Fellow is thick *B* 1, and large *B* 1.

The Iron-work of Wheels are these.

The Fellows are armed about without with Plates of Iron called *Dowledges*, thick *B* $\frac{1}{12}$ or $\frac{1}{12}$, large *B* 1; and so long, that they may cover the whole Circumference of the Wheel. Their midpart meets with the Joynt of the Spoke, and the Streaks joyn close unto the middle of the Spoke. Upon which are nailed Nayls with large broad Heads, and to their Naves, which are something turned over without, also are bound over the Streaks by a Stirrup narrow within, with its string or Binding of Iron.

Fig. XXV.

Fig. XXVI There are moreover high Stirrups, which bind

faſt the heads of the Spokes, faſtned underneath with their ſtrings of Iron. Fig. XXVII.

The Heads or Barrels of the Wheels are outwardly bound with four Rings of Iron, two in the thickeſt part near the Spokes, and two more towards the Extremity. Furthermore they have the Mouth furniſhed for the Axletree with a Bocchole of Iron, according to the uſe of all Wheels; if they ſhall be of Braſs, they ſhall be yet better, and more if they be upheld. *Fig.* 28. ſhews a Wheel compleatly furniſhed. Fig. XXVIII.

CHAP. II.

Of Carriages for Field-Peeces.

CArriages for Field-peeces are like thoſe for Culverings, and have the ſame proportion, except in theſe following particulars.

The *Cheeks* are thick *B* $1\frac{1}{2}$, for having onely one Diameter they will prove too ſmall, eſpecially in little Peeces.

The *Axletree* is not fortified with a Counter Axletree of Iron, being ſufficient to rule the Peece without that; nevertheleſs ſometimes they are fixed in Sakers.

The *Wheels* are high in Diameter *Boc.* 14. and in the Smeriglio and Falconetto they are without Meaſures, but that they may not prove leſs than 4 Foot about in Diameter, to the end that they may come unto the Parapets and Embraſures.

CHAP.

Chap. III.

Of Carriages for Canon of Battery.

ALL the Artists do not agree to determine the exact Length of Carriages for Cannon of Battery. Some would have them once and half longer than the length of the Chase or Cylinder, as in Culverings; some one time and one third; but the most commodious way is that they be made one time and a half, o B 2 8.

The *thickness* of the Cheeks are divers, according to divers Opinions. Some will have them B 1 always, other B $\frac{7}{8}$, others B $\frac{1}{4}$, other one B; in Peeces of 30l less, but in heavier Peeces, *viz.* from 30l upward they allow them 1 for 100. In fine they are less than the Mouth

The *largeness* of the said Cheeks are diverse At the forepart Cal. 3. $3\frac{1}{4}$. $3\frac{1}{3}$: at the middle Calibre $2\frac{1}{2}$, $2\frac{2}{3}$, 3.

At the Tail always Cal. 2, the End being something turned up upwards, is Calibre $2\frac{1}{2}$, o Cal. $2\frac{1}{4}$.

The Transomes are four, as in the Culverings; the Length is throughout equal, *viz.* much as the thickness of the Peece, near t Trunnions, and moreover the thickness of t half Cheeks for the Mortessing, to the end t said sides may de parallel. The thickness sh

be B 1, but better onely $\frac{1}{4}$. The largeneſs of the three firſt ſhall be B $1\frac{1}{4}$, but that of the Tail ſhall be of 2 B, or at leaſt B $1\frac{1}{2}$.

As concerning their *place*, that of the front ſhall be diſtant from the ſaid front B 1, or at the leaſt B$\frac{1}{2}$. That of the Breech, as is uſual. That of the *Manovel* or flat Tranſome ſhall touch the very half of the length of the Carriage, and that of the Tail ſhall be diſtant from the end B 1, or at the leaſt $\frac{3}{4}$.

The Trunnion holes ſhall be cut in the upper ſide, diſtant from the front B 3 compleatly, large B 1, and deep $\frac{2}{3}$.

The Morteſſing for the Axletree ſhall be diſtant from the front B 3 compleatly, (although ſome only will have them B $2\frac{1}{2}$) and diſtant from the upper ſide B 2 or $1\frac{1}{4}$, large B 1, or at the leaſt B $1\frac{1}{4}$. Throughly hollowed in the plain of the Cheeks, and in the lower ſide, as may be ſaid of the Culverings, according to the Commodity of the largeneſs of the Cheeks.

The Axletree may be long Cal. 13, round about as much as is ſufficient to comprehend the Carriage. Wheels and Locks thick Cal. 1, or Cal. $1\frac{1}{4}$. The reſt round and thick near the Carriage B 1, and without B $\frac{4}{5}$ round about.

The Wheels in Cannons even to 30l Ball, are made high in Diameter Calib. 10, in Cannons from 30l upwards Cal. 9. The Meaſure of the Nave, Spokes, and Fellows as aboveſaid, being of the ſame Diameter and proportion as thoſe of the Culverings.

The

The Iron-work of the Carriage, Axletree, and Wheels for Cannon of Battery, are the same as for the Culverings.

In the half Cannons, and as for Cannons fashioned like Culverings, and longer then is usual, they follow altogether the Measure and proportion of Culverings.

Fig. XXVIII. Chambred Cannons are not measured by the Diameter of the Chase, but by the Chamber.

Chap. IV.

Of Carriages for Cannons Petrieroes.

THE Carriages for *Petrieroes* have the same fashion as those for Battery, and are long once and a half, once and two thirds, or once three quarters of its proper Bore at the Touch-hole or Mouth. The most commodious and most reasonable is to make $1\frac{2}{3}$, *viz.* if the Soul of the Peece is long Calib. 9, the Carriage may be Cal. 15, or Cal. $15\frac{1}{2}$.

The bigness of the Sides shall be B $\frac{1}{2}$ or B $\frac{1}{3}$

The breadth at the forepart B $2\frac{1}{4}$, B $2\frac{1}{3}$.

At the Middle B $1\frac{3}{4}$, B 2.

At the Tail B 1. B $1\frac{1}{4}$.

The extremity of the Tail bends and is distant from the end B $1\frac{1}{2}$.

The Trunnion-hole is distant from the Front compleatly B 1, and is large or broad B $\frac{1}{2}$, deep $\frac{2}{3}$ of its breadth.

The

The Mortaſing for the Axletree is diſtant from the Front B $1\frac{1}{2}$, of the uppermoſt ſide B $1\frac{1}{4}$, and is ſquared round about B $\frac{1}{4}$.

The Tranſomes are thick B $\frac{1}{2}$, and wide B $\frac{1}{4}$; but that of the Tail B 1.

That of the forepart is diſtant from the ſame B $\frac{1}{2}$, and from the lower ſide $\frac{1}{4}$. That of the Breech diſtant B $\frac{1}{4}$ from the lower ſide, and that of the *Mannovell* or flat Tranſome from the uppermoſt ſide B $\frac{1}{4}$, betwixt which and the Center of the Trunnion-holes is ſuch a ſpace as is the length of the Peece from the Center of the Trunnions to the end of the Caſcabel, *viz.* B $5\frac{1}{7}$ about. That of the Tail is diſtant from the end B $\frac{1}{2}$, and from the upper and lower ſide B $\frac{1}{4}$ Fig. XXIX.

The Axletree is big in the middle ſquare B $\frac{1}{4}$.

The Wheels are high in Diameter B 6, the Nave is thick B 2, and long B $2\frac{1}{4}$. The Spokes B $1\frac{1}{2}$ compleatly, and moreover as much as is ſufficient for their Mortaiſing.

The Fellows thick and large B $\frac{1}{2}$.

Yet one muſt obſerve, that in Petrieroes of a ſmall Mouth, that the Wheels are to be made ſo high, that the Peeces may arrive to the Port-holes or Embraſures, *viz.* of three Foot or four about in Diameter; and in the Petrieroes of a large Mouth they do not make them higher in Diameter than five or ſix Feet, to the end that they may ſtand covered by the Parapets ordinarily ſix or ſeven foot high.

The Iron-work of theſe Carriages, Axletrees, and

and Wheels are the ſame as in other Carriages, and like Cannons of Battery.

In meaſuring and proportioning theſe Carriages, they may be valued from the B of the Chamber, by redoubling the number of the B of the Chaſe *&c.* and theſe meaſures in old Petrieroes become greater, becauſe the Chamber is larger from the end of the Chaſe.

The Carriages of Petrieroes *de Braga* (which on land are uſed in Towers and little Platforms, Fig. XXX. is a ſimple *Cavaletto* (or wooden Horſe) made of a crooked beam, with two Feet before, on which is fixed a great Fork of one entire piece of Iron, which doth Claſp the Trunnions. And under the Feet and the Tail they put ſmall little Wheels joynted in, to hale along with more facility the ſaid *Cavaletto.*

Fig. XXXI. But ſometimes this crooked Beam, in place of Feet before, is ſuſtained by an Axletree with its Wheels as in other Carriages.

To make Short Carriages for all natures of Guns, one muſt obſerve, that the half of the Carriage be juſt in the end of the Breech, putting the flat Tranſomes below in the hinmoſt part of the Carriage, *viz.* under the half, as is ſhewed in the *Figure* 12, in a Culvering Carriage.

CHAP

Chap. V.

Of Carriages for Mortar-peeces and Trabucchoes.

FOraſmuch as *Mortar-peeces* are not diſcharged but by method, and that raiſed from 45 degrees to 90, whereas other Artillery is never elevated above 45 degrees; therefore the Carriages ought to be different.

Thoſe for *Mortars* are made of three Sides or Cheeks, two for Sides, and the other for the the Bottom, all thick B $\frac{1}{2}$ of the Mortar.

Thoſe of the Sides are large or high B $2\frac{1}{2}$: the Trunnion which is all mortaiſed into the Cheek, occupies B $\frac{1}{2}$, the thickneſs of the Cheek at the bottom B $\frac{1}{2}$, the other B $1\frac{1}{2}$, and takes up almoſt all the inferiour part of the Mortar, *viz.* part of the Chamber B $\frac{1}{2}$, the thickneſs of the Breech B $\frac{1}{2}$, leaving a void place betwixt the Breech and the Bottom, to put the Coins more eaſily under.

The length in the top ſhall be B $3\frac{1}{2}$, that below B $7\frac{1}{2}$, whence leaving at the forepart B 1 faſtned, the Remainer may be bevil'd or without an Edge.

The Cheek at the bottom is long B $7\frac{1}{2}$, and large as is the Diameter of the *Trabuccho* on the outſide, is little more than B $1\frac{1}{2}$ with the Corniſhes.

This length of the Carriage is necessary, to the end that the Mortar being depress'd to 45 degrees, then giving great Shocks with the Carriage in the *Horizon*, and that it might not leap out, to which end it is necessary that the length of the Carriage be at the least double the height.

Others nevertheless make them only long B 6, because perchance they never make so low Shots.

To the Carriages commonly they never make Wheels, because in their March they are drawn upon Wagons; nevertheless to hale them along they put underneath four small Trucks, each made of an entire Plank, thick B $\frac{1}{2}$, high in Diameter B 1 $\frac{1}{4}$, with a hole for the great Axletree B $\frac{1}{4}$ about.

They bind together the Carriage with four thick Transomes across, two below, and two aloft, which encompass all the thickness of the Sides and Wheels, with a Plate of Iron nailed to and across in most places for strength, especially when the Sides are made of two pieces.

The Trunnion-holes are covered within with Iron, and there also they put their Contraforts. Within it enters the whole thickness of the Trunnions, which is closed with a thick Plate of Iron above, which covers all the upper part, and is there fastned with four garnishing Bolts and Pins, which pass over all the height of the Side, and are made firm underneath.

Nevertheless the said Plates or Bands one may raise up and lay aside, every time as you would

would mount or dismount your *Trabuccho*.

Lastly, there ought to be fastned outwardly on each Side two Rings, which will serve to mannage and carry the Engine from place to place. Fig. XXXII.

The *Trabucchi* have for a Carriage a strong Frame made of two Beams, distant as much as the *Trabuccho* is wide, made fast with two strong Transomes at the ends, with the Trunnion-holes in the middle, which are locked up with its Capsquares; and underneath are two Axletrees, on which are put two Rolers of Wood to conduct it, where there shall be necessity, which are drawn out and taken away when the *Trabucchi* is used.

END OF THE THIRD PART.

To divert the Reader after this third part, I have continued the story of the Bridg and Engine at Antwerp, *out of* Hondius *his Fortifications and Artillery, being a person very like to get the knowledg of it truly, an* Hollander, *and one of that party. pag. 96.*

"THere were two Vessels equipped, one "called the *Hope*, the other the *Fortune*, "which was fitted by *Pieter Timmerman*, In"geneer of *Antwerp*, and not by *Frederick Jen-*

" *nibelly*, though he had fitted many before, as " *E. de Meterèus* in his History relateth; for " he is abused, and assuredly *Timmerman* fitted " them, and in which he made a Chest of " strong Wood and Stone in a Triangular form, " as one may see in the Figure A; As long as " the Vessel, four Foot broad at the bottom, and " two at the top, and in which was put 18000 " pounds of Powder. At the bottom was a Pipe " of Latten, having little holes in the middle, to " give fire on all sides in an instant, coming a- " bove the letter A, from which went out four " other little Pipes, for to give more certain " fire at the time appointed. And then this " Chest was well built with with Square stones, " laid in Mortas all about, then covered with " Grave-stones in the manner of the Roof of " an house, and upon which Grave-stones there " were Gutters of fine Powder. And also he " laid 400 Wagon-load of Stones without " Morter or Sand, and upon the Tomb-stones " in the Gutters there were 24 Matches, which " ought to fire at the prefixed time; and also " they put Poles round about to hinder the " Enemy from boarding, and encompassed the " Vessel with great Pitched Casks which was " to be fired, that none could possibly enter, as " the Figure doth shew. The said *Timmer-* " *man* took with him a Captain named *Lank-* " *hear*, for to guide the Boats in the way, who " with his Seamen did so fit it, putting under- " neath a Sail, (that the Course of the River

might

"might better carry it before) a Foot under wa-
"ter, and the ſaid Captain put behind a certain
"Tail or Train, *viz.* faſtned behind the Rudder
"four Fathom long, and at the end was faſtned
"a great bundle of old Nets, with a heavy piece
"of Timber, which kept the Ship ſteady in its
"courſe, that it could not role or ſheer on either
"ſide; and being ſo finiſhed, was conducted in
"the night towards the Bridge, by the ſaid *Pie-*
"*ter Timmerman*, with other four Seamen in
"company to conduct the Rudder; and ſo floa-
"ting very near the Bridg, the ſaid *Timmer-*
"*man* fired the 24 Matches, and went behind
"the Rudder to the other Seamen, and imme-
"diately the Pitched Casks were on a light fire
"all about the Ship. They fired many ſhots
"from on both ſides the River, which forced
"*Timmerman* to retire as faſt as he could, after
"whom the *Spaniards* made many Shots, but
"all in vain. The Ship arriving at the Bridge,
"one would have thought that Heaven & Earth
"had finiſhed their courſe. When the Powder
"took fire, it gave ſo great a blow under water,
"that the water lept on the other ſide of the
"bank, filled the Fort on *Callo* ſide, and laid all
"the fields round about under water; all the
"Fire and Matches were extinguiſhed, the grea-
"teſt part of the ſaid Fort thrown down, and
"the Cannon loſt. One might have ſeen great
"heavy Stones fly in the Air, and driven half a
"League into the Countrey. It blew up ſix
"Ships of the Bridge, of which three were ſo

"torn, that one could not ſo much as find a "piece, the others caſt and thrown with their "bottom upwards, ſo that the Bridge was en- "tirely broke. There were alſo more than "800 people blown up, and ſome perſons of "Quality, as the Marquiſs of *Reesbork*, Gene- "ral of the Cavalry; my Lord *Billy*, formerly "Governour of *Freeze*, my Lord *Torſy*, and "twenty three Captains, and ſome of the Prince "of *Parma*'s Court, the Prince himſelf being "in great danger; for as *Metteren* relates, the "*Spaniards* made all their Endeavours to ex- "tinguiſh the fire by caſting in of water, which "they did all round about, (not dreaming of "the Powder, and that the Matches were then "ready to fire) begun to mock at its vain Ef- "fects, thinking that all the outward fire was "the product of this Engine. The *Duke* was "ſo long time a looking on, that all the fire "was quenched, but being already retired at "ſome diſtance, the Blow was given with ſuch "fury, that the Duke, and the Marquiſs of "*Guaſto*, and others that accompanied them, "were all blown down, and one could not per- "ceive the leaſt trace of Footing of the Fort "*Awſterwell*. But the ſaid *Timmerman* "willing that they ſhould purſue the Victory, "ſignified to the Lords, that there was made a "ſufficient hole or opening in the Bridge; but "ſome ſeeing from afar the *Spaniards* turning "and returning with Torches and Lanthorns "upon the Bridge, could not believe that there

was

" was a ſufficient overture made, or that it had " done any great effect, and therefore did not at " all follow that Advantage. In the mean time " the Duke repaired it with all imaginable di- " ligence, much admiring that the *Antwerpers* " and *Zealanders* had not taken hold of that " occaſion, and given an Aſſault. For the breach " was ſo great, that the City might have been " eaſily ſupplied with neceſſary Proviſions: " and from this, one may obſerve, how one " ought to follow a Victory undertaken, and " how one ought to conduct ſuch Works with- " out leaving of them in ſuch time, as the deſign " is ready to take effect. Moreover the Figure " (*A*) ſhews how the Ship was fitted a Stern, " with its Maſons work, and the Cask; and " how the Trains and Fuſes came within. Alſo " the Matches were dipped in Oyl of Turpen- " tine to give better fire together, for that gives " a blow as ſwift as Lightning. Above the " Stones were Fagots with Straw, and great " Trunks of green wood faſtned with chains of " Iron together, all about the Ship, as the letter " (*B*) doth ſhew, which could not but frighten " the Beholders.

THE FOURTH PART.

Of charging Artillery, and Preparations for the same.

CHAP. I.

Of charging and loading of Culverings.

THE *Culvering* carries a ball all of Iron. The *old* and *small* require Powder of 4, 1, and 1, as much as its proper Shot weighs of Iron: so that if there be 30l weight of Ball, it will have 30l of four, one, and one: or if one gives of five, one, and one, $\frac{4}{5}$ of the weight of its proper Shot of Iron, so that if the Shot weighs 30l, the Powder of five, one, and one shall be 24l.

The *Common modern* and *fortified* Peeces shoot Powder of five, one, and one, as much as the just weight of the Shot; so that if that weigh 30l, it also requires 30l of Powder of five, one, and one. Or if you would load it with Powder of six, one, and one, you may not give it above $\frac{3}{4}$ of the weight, *viz.* 22l $\frac{1}{2}$. But these may very well support a just and equal pro-

proportion of Powder to the weight of its Ball.

To put the Powder into the concavity of the Peece, they uſe either a Ladle, or a Paper-Cartridge.

The *Ladle* is an Inſtrument of Braſs, made as a gutter'd Pipe, and fixed at the end of a Staff; the form of it is ſuch, that for the Culvering it may ſerve to load it at two or three times.

If the Culvering is to be charged at two times, the weight of the Shot muſt not exceed 30 or 35 l; but the ſaid Culvering at three times may carry 35 more of theſe Pounds.

To load the Common Modern and Fortified Peeces at two times with Powder of five, one, and one, they make the Ladle with theſe Proportions: the part which is nailed upon the frame of the Handle, be long three Diameters of the Shot, (I do not ſay, Muzzle or Diameter of the Bore) and long one, that part which receives the Powder be long Shots 4, and large in the bottom Shots 2 leſs $\frac{2}{6}$, and at the top Shots 2 leſs $\frac{1}{3}$, that the point be round, making the Center one Shot, or at the leaſt $\frac{1}{8}$. At the Ears they make inwardly two quarters of the Circle for ſtrength, and at the Point they cut away from ſome $\frac{1}{6}$ of the Diameter, to the end that the Ladle may better touch the bottom of the Chaſe.

Others make large the under part for the Powder, $\frac{3}{5}$ of the largeneſs for the Model or Frame, leaving each Ear large $\frac{1}{5}$.

To charge the same Culverings, Modern and Fortified, at three times with Powder of five, one, and one, the Ladle is made long Shots $2\frac{2}{3}$, the rest as the others.

To load the Ancient small Peeces with Powder of five, one, and one, (for that of four, one, and one is now out of use,) the said Ladle shall be shortned $\frac{1}{5}$ about, (the two said Powders being not much different in mass or weight,) or if with the Ladle you shall use that of five, one, and one, but smooth, not heaped up.

To load the Common Modern Peeces with Powder of six, one, and one, the Ladle shall be $\frac{1}{4}$ part above shorter than that of five, one, and one; or if you will work by the same, but smooth, not filled top-full.

To load the Modern Fortified with Powder of six, one, and one, or it it shall hold the common quantity, or if you shall yet use the same top-full, give it the full weight of the Ball.

Lastly, to load the Old small Peeces with Powder of six, one, and one, the Ladle shall be used, shortned $\frac{2}{5}$ or $\frac{1}{3}$ of its accustomed measure.

Observe here, that the three Powders are not proportionable in substance, weight, and activity, whence it is that if it hath the said proportion, which is oftner more probable than true; wherefore one ought to have it made clear by Experience.

The said thin Plate of Copper, cut out after the abovesaid manner, is bended round, and is nailed with Studs of Copper to one module long

Ladle, *Fig.*34.

A Rammer, *Fig.*35.

A Spunge, *Fig.* 36.

A Worm, *Fig.* 37.

A Craper, *Fig.*40.

A Peſſel, *Fig.* 41.

A Driver, *Fig.*42.

A Lanthorn, *Fig.*48. A Caſe, *fig.*49.

A Boumb, *fig.*51. Stuffies, *fig.*50. A Cart. *fig*47

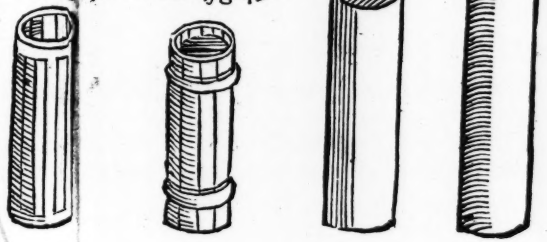
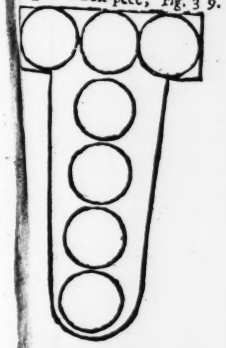


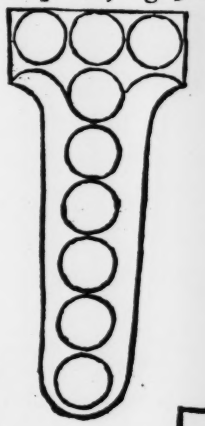
*Fig.*44.

A Cartridge, *fig.*46

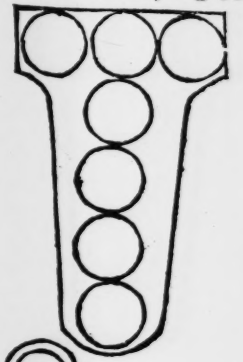
The quantity of Powder which muſt be for the loading of a Bell-peece, *Fig.* 39.

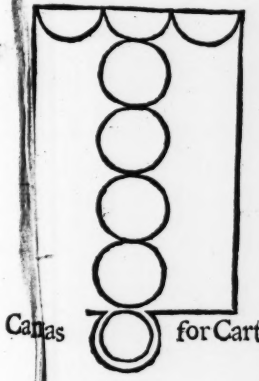


The quantity which muſt be uſed for the loading of a Field-peece, *Fig.* 38.



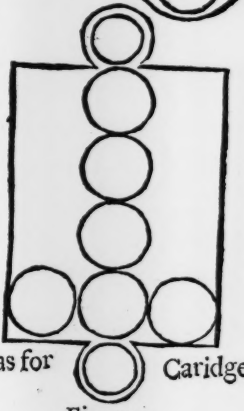
The quantity which muſt be for the loading of 12 Culverings of Powder, *Fig.*33.





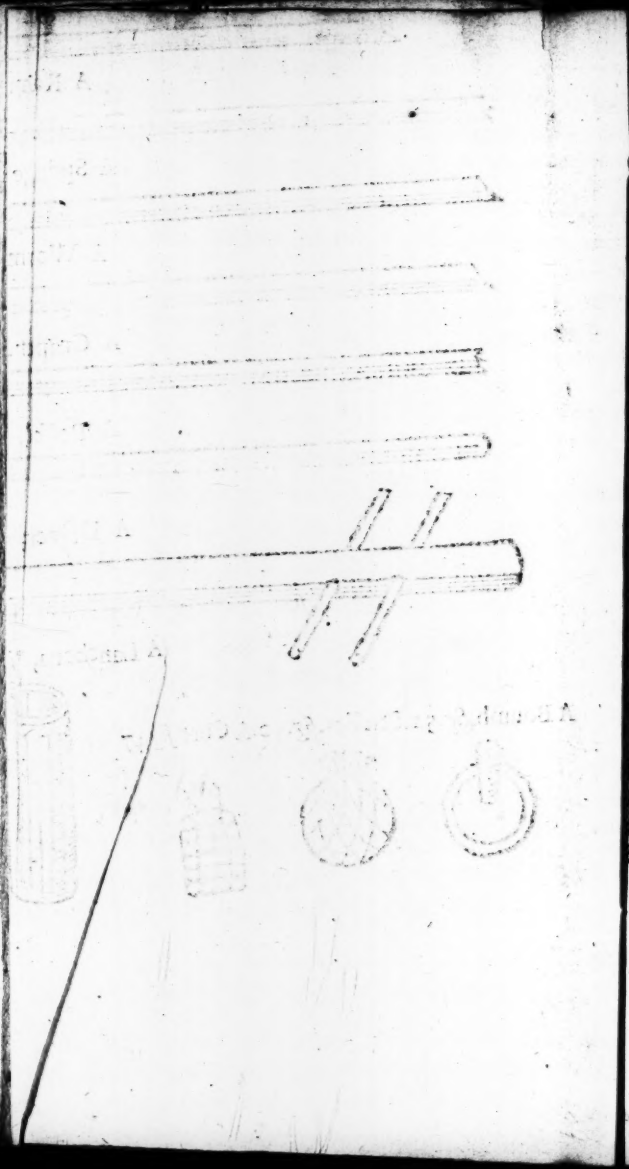
Canvas for Cartridges

*Fig.*45.



Canvas for Caridges,

Fig. 43.



long a Shot 1½, but ſomething ſmaller before, for the faſtning the Plate, and moreover long to faſten the Staff or Handle, an Inch and ½ in Diameter, that it advance out of the Bore at the leaſt one Foot. Beſides the Ladle there be other Materials or Preparations for the Cannon, which ſerve for Charging, as the *Rammer*, *Spunge*, and *Wadhook*. Fig. XXXIV.

The *Rammer* is a piece of wood, round and thick one Sh. and long one Sh. ½ about, having a Staff or Handle like the Ladle, and ſerves to preſs and ramm home the Powder into the Cannon, Wadd, and Shot, and is made of hard Wood, and is ſometimes plated about with a Plate of Copper near the head for ſtrengths ſake. Oftentimes they uſe upon the ſame Staff both the Ladle and Rammer. Fig. XXXV.

The *Spunge* is no other then a Rammer-head, made of ſoft wood, and leſſer in Diameter than the aboveſaid by ⅓, wrapped round about with a Sheep's skin, and faſtned with Studs of Copper, which ſerves to make clean and refreſh the Peece Fig. XXXVI.

The *Wadhook* is another Material, made of a Rodd or great Wire of Iron, turn'd in a Serpentine manner, and in its end is put upon a Handle or Staff to draw out Wadds or Okume, that the Peece may be unloaded. Fig. XXXVII.

CHAP.

Chap. II.

Of the Charges for Field-peeces.

Field peeces carry a Shot of no more than 10 or 12 of Iron, which is always used, although sometimes in the smallest a Ball of Lead.

They are always allowed Powder of five, one, and one, of equal weight to its Ball, if they are Common Modern or Fortified; and if they are Fortified, they are also allowed the same weight of Powder of six, one, and one: but if they are Old small Peeces, they are only allowed $\frac{4}{5}$ of Powder of five, one, and one, or $\frac{4}{5}$ of that of six, one, and one.

They are loaded with the Ladle at one time with Powder of five, one, and one. The body of the said Ladle, *viz.* that part which holds the Powder, shall be Shot $7\frac{1}{2}$, as was said of the Culvering, the Model large as accustomed, Shot 3, and long sh. $1\frac{1}{2}$, in the rest as those of the Culverings. Fig. XXXIII.

That serves for Powder of five, one, and one in Modern Peeces, and for that of six, one, and one in Modern Fortified.

For the Small old Peeces they use the same, but smooth, not heaped up, with Powder of five, one, and one.

CHAP.

Chap. III.

Of the Allowance of Peeces of Battery.

They are commonly charged with Shots of Iron, giving them $\frac{2}{3}$ of the weight of the ball of Powder of four, one, and one, in the Ancient; and of five, one, and one, in the Modern Common and Fortified.

The Cannons which carry from 30 to 351 Shot, are loaded with a Ladle at two times, but thoſe which carry a greater Ball at three times. For to load at two times, they uſe a Ladle long in its Cavity three Shot, with the outpart Model or Frame which is one Shot, or little leſs, the reſt being after the uſual form.

For to load at three times, let it be long only in its cavity Shots two, and for the Model $\frac{1}{5}$, the reſt being made as is uſual.

And theſe ſerve, being ſmoothed, for all ſorts of Powder reſpectively; and if you would load Old Peeces with Powder of five, one, and one, you muſt uſe it ſmoothed, not heaped up; and moreover in loading the Modern Fortified, with Powder of ſix, one, and one, they uſe it alſo ſmoothed, not heaped up.

For Cannon Chambred, take the Diameter of the Chamber, ſubſtract the Wind, and the reſt will ſerve for a Meaſure in making the Ladles.

For

For to load at two times, its Cavity must be long $3\frac{1}{2}$ of its Diameter; and if for three times, let it be long $2\frac{1}{3}$ of its measure, the rest as is usual,

In Taper-bored Peeces, the Ladle is made according to the form of the said Tapering, *viz.* narrower before than behind; near the Model or Shaft the Cavity is made large Shots 2, and at the Point is made large Diam. 2 from the bottom of the Tapering, long 3 Sh. and $\frac{1}{2}$, or 4 and the part of the Model large 3 Sh. and long Shots $\frac{1}{2}$ or $\frac{1}{4}$.

Fig. XXXIX.

Chap. IV.

Of the Allowance for Cannons Petrieroes.

ALL *Cannons Petrieroes* carry a ball of Stone, or some Artificial body, as Sacks, small Barrels, Cases of wood, bags fill'd with Stones, and Bur-shot, but never heavier than the ball of Stone.

Petrieroes have their Chambers large $\frac{1}{6}$ of the Mouth, they are allowed Powder of five, one, and one, $\frac{1}{3}$ of the weight of its Stone-ball, and are loaded at one time with a Ladle long in its Mouth two Diameters of the Chamber (substracting the Vent,) the rest framed as is usual. Others say, that the Ladle long in the Cavity B $1\frac{1}{3}$ of the Chamber, will load at two times the third of the Stone-ball.

To Petrieroes large in the Chamber, the half of the B are allowed Powder of five, one, and one, commonly the half of the weight of the Stone-ball, and are loaded either at one time with a Ladle long B $2\frac{2}{3}$ of the Chamber, or at two times with a Ladle long B $1\frac{1}{3}$ of the Chamber, taking away the Vent, and the reſt, as uſually is made.

Others nevertheleſs ſay by experience, that in theſe Petrieroes the Ladle being long (ſetting aſide the Wind) B $3\frac{2}{5}$, gives at two times one third of the weight of the Ball, and at three times the half of the weight of the Ball of Powder of five, one, and one.

In the following Petrieroes is given Powder of five, one, and one, in weight $\frac{1}{3}$ of the Stone-ball, and the Ladle long in the Cavity Ball $\frac{1}{4}$ to load at one time.

The Chambred Petrieroes are more eaſily loaded with Cartridges (of which we ſhall ſpeak) than with the Ladle; they alſo put the Cartridges cut open in that part towards the Touch-hole upon a Cartridge Ladle of wood, made in form of a Roof-Tile of a great houſe, as great as is the Open of the Chamber, and altogether is thruſt forward into the Chamber. Then the Chamber is ſloped up with a Tampion of ſoft wood put in by a Spears point, as *Fig.* 41 ſhews. Then it is well rammed in with a Rammer, having a ſmall Wheel made underneath, and two Handles a croſs, as the *Fig.* 42. and under which they put a Wadd of Hay or Okame, Fig. XL. Fig. XLI. Fig. XLII.

Okame, to the end the ſaid Tampeon in driving may not break by the Stone-ball, and after which they put another Wadd without towards the Muzzle.

The *Petrieroes de Braga* carry the ſame Charge as the others. The Powder is put into the *Moſcolo* or Chamber, and is cloſely ſhut up with a Tampeon and a Shot put into the Chaſe with a Wadd before and behind, and the *Moſcolo* is fitted into the *Braga*, and cloſed with a Coin of Iron behind.

Chap. V.

The Charge of Mortars.

THE *Mortars* or *Trabuccho's* are loaded as the *Petrieroes*, with Stone-ſhot, but oftner with Artificial fires, Bombes, Bags fill'd with Hail-ſhot, and Stones, but not heavier than the Ball.

The Powder is not always of the ſame quantity, but ſometimes more, ſometimes leſs, according to the intention of the Gunner. The Ordinary is $\frac{1}{5}$ of the weight of the Stone-ball, which being put into the Chamber is cloſed up with a Tampeon of Wood, and above is Rammed a Wadd of Hey or Okame before the ball of Stone; but in ſhooting Artificial Fires they do not work with a Tampeon, to the end that the Fire of the Chamber may kindle the Fire Ball or Granadoe.

Chap. VI.

Of Cartridges of Powder.

ALL Peeces of Artillery are loaded with Powder after two manners, *viz.* either with a Ladle as aforesaid, or with Cartridges, which are used in Forts by night; and upon the Sea, for dispatch and security in not firing the Powder. They serve for all sorts of Peeces, but principally for the Inchambred.

They are made of Cloath or Canvas sewed upon its Funnels, or of Paper sewed or glewed; being fitted, they are so thick, that they may conveniently enter into the Chase or Concave for which they are made: therefore the largeness of the Paper or Canvas shall be always three Diameters of the Bore or Chase, or Chamber. Its Former must be of the same Diamer, the Length is diverse according to the Peece for which they are to serve, and according to the Powder which they are to contain. For the Culverings they may be long Shots four; for the Cannon of Battery, three almost; for the Petrieroes, two Bores of their Chamber. Nevertheless it is good to weigh the Powder, which one puts within, and to see how much it takes up in practice. Fig. XLIII.

For those of Canvas, one may take a Former, and of the other part a Ligature or binding, giving XLIV.

Fig. XLV. XLVI. ving therefore to the Canvas half a Bore more in length.

Before you put your Cartridges into the Chaſe, you cut and open that part which is near the Touch-hole.

Chap. VII.

Of Artificial Bodies uſed in ſtead of Shot, viz. *Bags fill'd with Hail-ſhot, Caſe-ſhot, Tunnel-ſhot, Baſe and Bur, and Bombe or Granadoes.*

THey do not always charge Artillery with Iron-ſhot or Stone, but oftentimes with other Artificial Bodies, or bags of Hail, Caſe, Baſe and Bur-ſhot, and Bombes.

The *Bags* are made of Canvas, and are filled with ſmall ſhot of Lead of one or two Ounces, which ſerve to load Field-peeces, and thoſe for the Cannon for to ſcatter wide abroad, either in the Field or upon the Walls in the time of an Aſſault. They are in Diameter 1 Sh. in length 1½. Thoſe of ſmall Artillery weigh one time and a half more than the Iron-ſhot; thoſe for Cannon are of the ſame weight as the Iron-ſhot. The Shots are placed in order, and the Bags without are tyed with good Twine, which paſſeth betwixt the Chinks of the Balls, croſſing like a Lettice.

Fig. XLVII.

The *Caſes of Wood* ſerve for Petrieroes, and Cannon

Cannon of Battery, are made in form of a Cylinder or Column, with two Funnels or Squares of the ſame wood, diſtant one from the other one or two Inches. They are filled with Lead-ſhot, Stones, Chain-ſhot, pieces of Iron, *&c.* Although ſome make the Tonnels narrower at one end than the other, but neither ought to be heavier than the Stone-ſhot. Fig. XLVIII.

The *Tonneletti* or Tonnel-ſhot are as the Caſe-ſhot, but have their Pipe ſtands equally in Diameter at both ends, and are bound about with two Hoops of Iron or thin Plates, in the middle of one is faſtned a piece of Cord to draw it out of the Peece, as occaſion ſerves. They are filled with the ſame materials as the Caſes of Wood. Fig. XLIX.

The *Stuffies* are made of ſoft Iron Wire, woven as a Net, and are filled with the aboveſaid Ingredients, are cloſed up as a Purſe, and ſerve properly for Mortars. Fig. L.

The *Bombes*, are great balls of Iron or Braſs hollow in the midſt, and in which are put fine ſifted Powder; and they give them a due fire by a Fuſe, or ſmall Trunk of Wood or Mettle fill'd with Powder, or other beaten ſubſtance, to the end that the Bombes may break as ſoon as they are come amongſt the Enemies. They are uſed by Calibres of Iron from 50, 100, to 300l, with ſuch a *vacuum* that may onely commodiouſly weigh the half. They are different from Granadoes onely in bigneſs, becauſe the Granadoes are leſs, and are caſt by hand,

are of Calib. of Iron of 15l, and with such a *vacuum*, that they may onely weigh about $\frac{2}{3}$. Some to save charge are made of Glass and Earth, but do not so great effect, and therefore are seldom used.

Furthermore, there are used divers Fire-balls, the making of which you may learn from *Fire-Masters*.

END OF THE FOURTH PART.

A farther Relation of the making of the Bridge over the Scheld *near* Antwerp, *and of the Effects of the Fireships; taken out of* Famianus Strada, *the sixth Book of his last Part.*

"ABout the latter end of the Summer 1584, "the most worthy Captain and General, "*Alexander* Prince of *Parma*, with less than "20000 Soldiers besieged *Antwerp*, *Ghent*, "*Tendermond*, *Bruxels*, and *Mecklin*, all at "once, and within the year took them, and ma- "ny other Cities besides. *Antwerp*, a great "City, wherein were 100000 Souls, besides "Seamen and Watermen, and whereto belon- "ged above 1000 goodly Vessels, and was then "the greatest City of Trade in the world, put "the Prince most to it, having the River "*Scheld* open, and thereby supplied with all "Provisions and Ammunition from *Zealand* and

"and *Holland*. That after ſome time he found, "that unleſs he could bridle the River by a "Bridge, it was not poſſible for him with ſo "few Forces to take the Town. Therefore "betwixt *Antwerp* and *Lillo*, a little more than "midway, over againſt *Callo*, he reſolved to "build a Bridge, and to that end built two "Quadrangular Forts, that on *Flanders* ſide "called St. *Maries*, and that on *Brabant* ſide "St. *Philip*; and cloſe to the water ſide at "both ends, where he intended the Bridge "ſhould end, he built two ſtrong Batteries or "Caſtles, 50 Foot ſquare, upon long and big "Timbers, and furniſhed them both with very "great Guns, on purpoſe to ſtop the Veſſels, "and ſecure the Carpenters and Workmen up-"on the Bridge, and to be a Magazine for "Ammunition. And to the end he might "bring Timber, Ships, and other Materials for "this great work, (after the Delivery of *Ghent*) "he cut a Navigable River fourteen Miles long, "which fell into the *Scheld* near *Callo*, by "which he was ſupplied with Victuals and o-"ther Proviſions, as well as Materials for the "Bridge abundantly. The River at this place "was about 2400 Feet over betwixt the two "Caſtles, and towards *Flanders* ſide for 200 "Feet, and on *Brabant* ſide for 900 the Ri-"ver was not ſo deep, but that long Timbers "might be fixt into the bottom of the River, it "being ſandy and ſound; therefore at the di-"ſtance of eleven Feet, and thirteen alternately,

there

"there were with Bell Beetles at each diſtance "three long Rafters driven into the bottom of "the River, five Foot aſunder, and formed like "a Truſſel or Peer, [as our Bridges at *Staines*, "and like to *Downham* and *Stow* Bridges over "the *Oaſe* in *Norfolk*] and bound with croſs "beams and Timbers. Theſe Rafters or great "Timbers, when driven ſufficiently down, were "cut equally high, and mortaiſed into a ſtrong "Timber, to bear the Liggers of the Bridge. "Of theſe Peers or Truſſels there were 18 to-"wards *Flanders*, and 74 towards *Brabant*, all "ſtrongly cover'd with Plank 12 Foot wide, "and on each ſide a Breſt-work five Foot high "Musket proof, and eight Soldiers might well "march a breſt on the top. Before each Peer or "Truſſel there were many ſtrong Piles driven "triangular ways, for the keeping Veſſels from "running upon the Bridge, and at 20 Foot di-"ſtance on either ſide great Piles driven to that "end. Now for the Remainer of the River, that "lay betwixt theſe two ends, which was neer "upon 1300 Feet, and which was ſo deep that "no Piles could reach the bottom, there were "thirty two Ships or Veſſels brought down "*Alexander*'s new River, of 66 Feet long and "12 Feet wide (called with us *Bylanders*) and "placed with Ankers and Iron Chains, in a four-"fold row, 22 Foot aſunder, ſo as they might "riſe and fall with the Tides, which was about "12 Foot,) and the ſpace betwixt each Ship "was laid over with five long Beams, plank'd,

and

" and had Breaſt-works, and was as wide as the " Bridges before nam'd were. On every Ship " ſtood thirty Soldiers, and four Seamen, with " two great Guns, one at each end of the Veſ- " ſel. There were for the Defence of this Bridge " near 100 great Guns ready planted into the " two great Caſtles and Veſſels, beſides the " great Guns in the Forts St. *Mary* and St. *Phi-* " *lip*. This Bridge being thus finiſhed, it yet " was thought fit, before and behind the Ships " or Veſſels (*viz.* for 1300 Feet) to arme the " ſame with eleven Barricadoes, (like half " Moons before Bridges or Gates.) Each Bar- " ricado was made of three great Lighters, " made faſt to one another, and formed in fa- " ſhion of a Triangle, with three Ankers and " Chains, to ſuffer them to riſe and fall with the " Tides: theſe were covered over with Maſts " and great Timbers, and ſtood about 100 Feet " one from another, and were placed ſome 150 " Feet from the Bridge both wayes. From " each of theſe Barricadoes came out 40 long " Piles ſharpned at the ends, and armed with " Iron, to terrifie the Veſſels, leſt by running " upon them, they ſhould be deſtroyed. The " Lighters were fill'd with empty Caſk, Iron " bound, leſt they ſhould ſink by Accident. " Laſtly, the Prince armed fourty Veſſels, twen- " ty on each ſide, for the defence of this Bridge, " and ſo after ſeven Months hard working, this " great Work was finiſhed, and gave paſſage to " all, and the day was ſolemniz'd with great

" Joy. The *Antwerpians* were more remiss " in hindering the Progress of the making the " Bridge, because they thought it was impossi- " ble, and said, *that the* Scheld *would no more* " *endure any to bridle it, then the Free* Belgi- " ans *would indure the* Spaniard *s Yoke*: but " when they saw the Work proceed on, and be " almost finished: They sent a Spy out of *Ant-* " *werp* to view it, and bring them an account of " the Prince's Actions, who was discovered and " brought to the Prince; but contrary to ex- " pectation was sent to see all the Forts and Ca- " stles, and Bridge, and bid by the Prince to " go and tell them that sent him, what he had " seen; and to assure them, that he should not " depart from that Bridge, before he should " find either a Tombe under it for his Grave, " or to pass over it into the City. The first " thing that the *Antwerpians* did, was by help " of Seamen in the Night to cut the Cables of " the Floats or Barricadoes under water, which " to some they did, which presently the Prince " altered to Iron Chains; and most of this time " was spent by the *Antwerpian* Ingeneers, to " whom was sent an *Italian* by Queen *Eliza-* " *beth*, called *Frederick Jembelly*, one that had " extraordinary skill in Fire-works, and was " famous for the same, neglected by the *Spani-* " *ards*, and therefore willing to do them all the " mischief he could. These Ingeneers prepared " many Fireships for the destruction of the " Bridge, many whereof came to little effect.

There

"There were two made, called the *Hope*, and "*Fortune*, of about 100 Tun apiece: there "were in each Vaults made of Stone and Mor-"tar, fill'd with 200 barrels of Powder each, "and above great quantities of Grave Stones, "Mill-ſtones, and other great Stones form'd up "into an Angle, and the Concavity at the top "was fill'd with balls of Iron, Marble, "Chains of Iron, old Ankers, Plow-Coulters, "and all that theſe Infernal Workmen could "deviſe to deſtroy men withall, [a more perfect "deſcription whereof you had at the end of the "third Part.] The Prince hearing of all theſe "Preparations, was not idle to ſtrengthen his "Guards, and make ready for their coming, "which was on the 8*th* of *April* at night 1585, "when behold firſt three Veſſels appeared from "the Town all on fire, afterwards other three, "and ſo three after three, 'till fifteen Veſſels "came down, and burnt ſo as if all thoſe Veſ-"ſels had been one fire. Had not the Spectators "been full of Care and Fear, certainly a more "pleaſant Spectacle could not be ſeen; all the "Bridge, Caſtles, Forts, and ſides of the River "were full of the Prince's people with their "Colours, moſt with Torches in their hands, "and all the Veſſels with Fire-works burning, "ſo that it was light as day. Thus came theſe "Veſſels, directed by Seamen and Pilots, with-"in 2000 Paces of the Bridge, down the Chan-"nel; when as thoſe Seamen and Pilots firing "their Trains and Matches, leapt into their Boats,

" Boats, and went back to obſerve what ſucceſs
" their Engines would have. But the Veſſels
" kept not their Channels as was expected, but
" ſome went one way, ſome another; four ſunk
" in the midſt, ſome run a ground on *Callo* ſide,
" and ſome were boldly boarded by the
" Prince's Souldiers, the Matches put out, and
" Veſſels taken. This made all the Beholders
" rejoyce, and ſcoff at theſe Engines, when be-
" hold the greateſt Veſſel, that had all thoſe
" dreadful Fires and Stones, and was fitted pur-
" poſely for deſtruction, came clear off all the
" Barricadoes and Floats, and fell cloſe to the
" Bridge, which drew the Prince of *Parma*
" thither with the moſt of his principal Officers,
" who command the Seamen and Soldiers to
" put out and quench the Fires, being ignorant
" of the Infernal works within, and that all
" this time the Fuſees were burning in order to
" the great Blaſt that followed. There was a
" *Spaniſh* Enſigne, whether by the knowledge
" he had of *Jambelly*, or by Divine Inſtinct,
" that upon his knees deſired the Prince to get
" far from that Veſſel; the Prince was angry
" with him, but when the Enſign with more
" courage begun to preſs him, He, with *Guaſto*
" and *Cajetanus*, two great Lords, departed
" toward St. *Maries* Fort, leaving the Lords
" *Billy* and *Rubais* in the Caſtle or wooden
" Battery at the end of the Bridge, with many
" other Commanders; but juſt as the Prince
" with theſe Lords were entring into St. *Ma-*

ries

"ry's, the Fuſees had come to the Powder,
"and this deadly Veſſel broke, and gave ſo
"great a Crack, that one ſhould have thought the
"Heavens had come down, and the whole bo-
"dy of the Earth had been ſhaken; and throw-
"ing abroad thoſe dreadful Stones, Chains,
"Shot, *&c.* there followed a lamentable ſlaugh-
"ter, ſuch as never had been heard of before.
"For though the Prince had been gone a quar-
"ter of a Mile from the Bridge, yet not onely
"Himſelf, but the Marquiſs, and all thoſe by
"him, were violently blown to the ground, and
"ſome taken up for dead. That Caſtle or Bat-
"tery next St. *Marys*, at the Bridge-end, where-
"in were the aforeſaid Lords, and many Com-
"manders, Soldiers, many great Guns and Arms
"were all driven as leaves before the Wind, and
"ſunk down, without ſaving any Man's life, or
"leaving any ſign of ſuch a place. The *Scheld*
"ſhewed its bottom, and his Waters aroſe
"above the banks, and fill'd the Countrey
"a Foot deeper of Water than before; the
"Earth did ſhake for 9000 Paces off; the
"great Grave and Mill-ſtones were ſome of
"them found a 1000 Paces from the Bridge
"buried deep in the ground; many were kill'd
"who were near the Fire, many by the Water,
"and divers by the evil ſtink that was made
"there. Some were blown many Paces off into
"the River, and yet ſaved alive. The number
"of thoſe that were ſlain amounted to near
"1000, and neer as many hurt and wounded.

This

" This was a lamentable Night, nothing but " Groans and Mourning to be heard; all la- " mented for the Prince, thinking he had been " in the wooden Fort that was deſtroyed, nei- " ther was he ever ſo near Death, being taken " up ſore bruiſed, & not able to ſpeak, L^d *Guaſto* " having hold of his Legs, and *Cajetane* woun- " ded with a Brick in the Head. But a little " after the Prince recovered, and returned to " the Bridge, where he found the Caſtle or " Battery quite gone, ſix of his Ships tore to " pieces, much of the Bridge torn and ſhaken, " many of his faithful Captains and Soldiers " kill'd, and his Deareſt Friends, Lords *Billy* " and *Rubais* blown away. Yet for all this, " calling together the Remainder of his Men, " and many Commanders coming with their " men from many parts to him, by the reaſon " of the noiſe of the Blow, he ſo incouraged " them, that before Light Day, by gathering " together the Maſts, Rafters, and Veſſels, and " other Materials, he had cloſed up the Breach, " ſo that the Soldiers and Footmen might walk " over, and which amazed the *Antwerpians* " above the Bridge, and the *Zelanders* below, " that they did not believe the Bridge was bro- " ken, which was only the cauſe the Town was " not relieved, there lying 200 Sayl at *Lyllo* " ready to come to the City, *&c.*

Thus much out of *Strada*, by which and the former Diſcourſes, at the end of each Part, it will be eaſie for the Reader to underſtand this great

great Action, far exceeding *Cæſar*'s Bridge over the *Rhyne*, and equalling great *Alexander*'s Actions at *Tyre*. And I have been more deſirous to ſet this punctually down, becauſe in a great meaſure it was the cauſe of *England*'s ſafety in that terrible year 1588, being done but three years before, and being freſh in the *Spaniards* memory, cauſed them, upon ſight of the *Engliſh* Fireſhips, coming burning towards their Fleet before *Calais*, to cry *Jembelly, Jembelly*, cut their Cables, and many Ships run themſelves a ſhore.

THE

THE FIFTH PART:

Of shooting in great Artillery.

Chap. I.

Of necessary Operations before Shooting.

TO shoot securely in *Great Ordnance*, it is necessary that the Peece be first well Tertiated or Squared upon its Carriage, and that one knows duely to Load and Level the Peece.

To *Tertiate* a Peece, is to know if it hath its due thickness at the three places, *viz.* Touch-hole, Trunnions, and Neck; if the Trunnions are rightly placed, and the Chase streight.

To *Quadrate* a Peece mounted, is to see if it is directly placed, and equally poised: which diligence is used in the Carriage, in regard of the Wheels and Axletree. Also to Quadrate a Peece, signifies to find in the Convex Superficies of the Base and the Muzzle-ring, the point which is perpendicular over the Soul of the Peece or Cilinder, which is done by an Instrument called the *Level*, hanging upon both Cor-

nishes

Fig. 52.

Fig. 53.

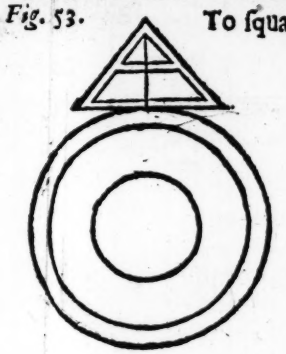


Fig. 55.

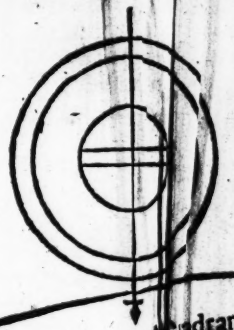
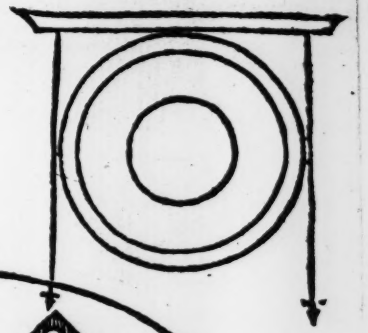
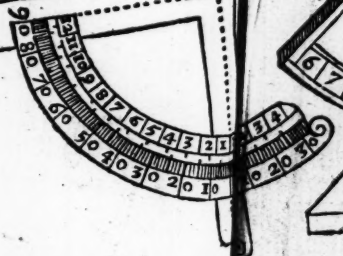


Fig. 54.



A Quadrant for Gunners. Fig. 57.



A Quadrant for Gunner-Pieces. Fig. 58.

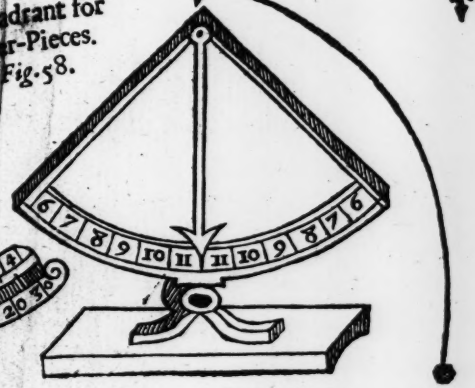
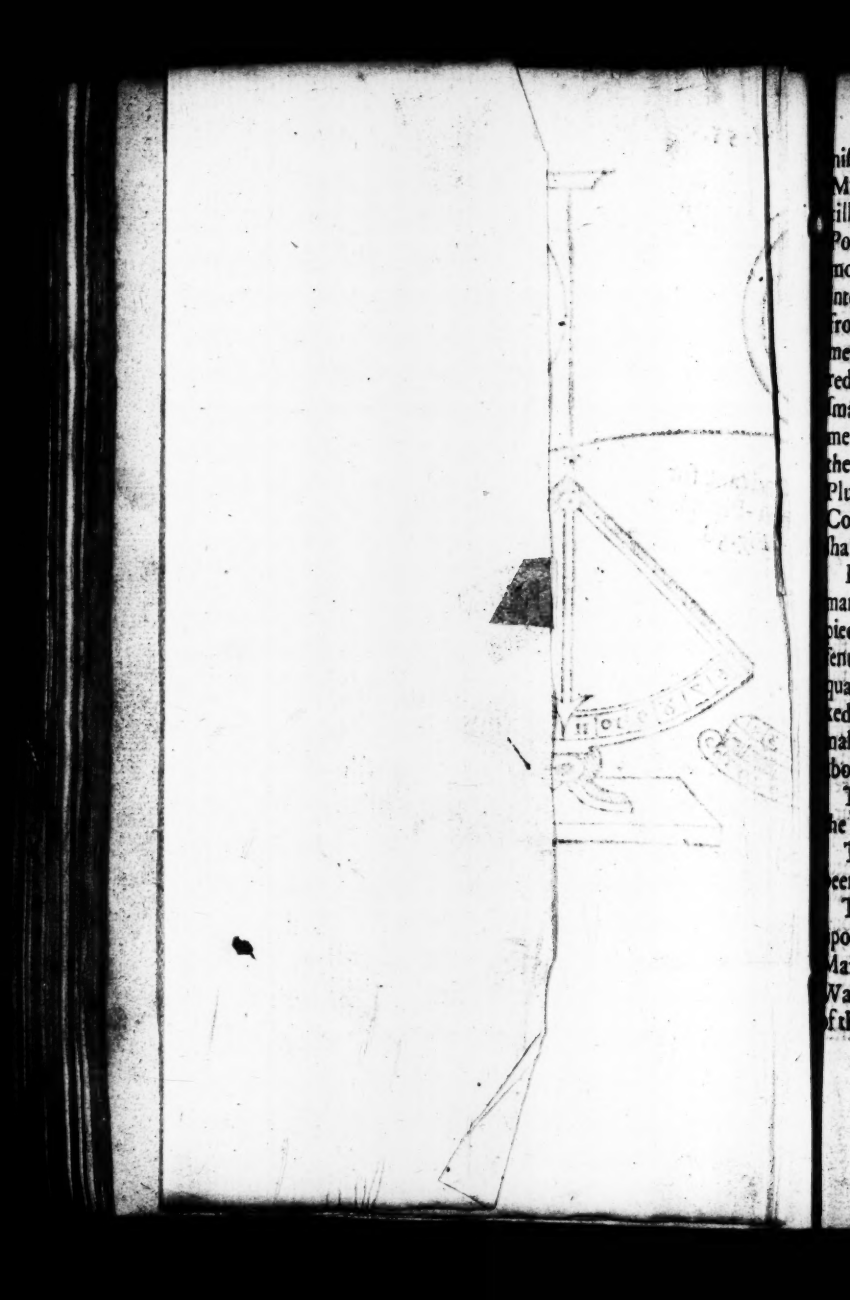


Fig. 56.



niſhes, and when the Thread covers the proper Mark, moving by little and little the Lead, untill it touches the Corniſh, which ſhall be the Point required. See the *Fig.* 52. But it will be more exact and eaſie to have the Level in the interior Baſe, and in it marked ſtrait the Point from the perpendicular line, which touching immediately the Corniſh, will ſhew you the deſired Point. One may do the ſame thing with a ſmall Line croſs the Corniſh, with two Plummets which touch the ſaid Corniſh, and dividing the part of the Line comprehended betwixt the Plummets in two equal parts, the Point of the Corniſh which ſhall be under the ſaid Diviſion, ſhall be that required. See *Fig.* 54.

Fig. LII.

Fig. LIII.

Fig. LIV.

For what belongs to the Muzzle-ring, this manner will be eaſieſt. That one ſtick a little piece of Wood croſs the Mouth, which repreſents the Diameter, in the middle of which equally diſtant from the ends, are noted or marked a Point; then hanging a Plummet, and making it touch the Center, you ſhall ſee noted above the Point deſired.

Fig. LV.

Theſe Points upon the Rings ſerve to place the Diſpart.

The things belonging to load a Peece have been before ſpoken of.

To *Diſpart* a Peece, is to place, fix, or elevate upon the convex Point of the Muzzle-ring a Mark, (which is ordinarily done with a little Wax Candle,) as far diſtant from the Cylinder of the Peece, as is the Point of the Baſe-ring; to the

the end that the Visual Ray which passeth by these marks, may be parallel to the said Chase, to make Shots at Point blank.

To find the Dispart, *viz.* the difference of the Semidiameters of the Cornishes, which is either with Calliper Compasses, or with a Priming Iron thrust into the Touch-hole to the opposite part of the Chase, placing that difference upon the top of the Cornish-ring near the Muzzle, over the Middle of the inferiour Cylinder.

Chap. II.

Of several Differences and Ranges of Shot.

As to the several Shootings in Artillery, the Ball being shot out, flies through the Air with a violent, mixt, and natural motion, describing a Parabolical Line, in whose beginning and end are lines sensibly streight, and in the middle curved. In the beginning the Impress Force driving forwards by the Fire the natural gravity of the Ball, describeth a right line; in the middle that force diminishing, and the natural gravity prevailing, describeth a crooked line; in the end the natural gravity overcoming the Impress Force, which becomes weak or altogether faints, describes of a new a right line, in which the Ball tends towards the Center of the Earth, as towards a place natural to all heavy bodies, as doth shew the *Fig.* 56.

Fig. LVI.

The *Shooting* or Shots in Artillery are therefore three. The first called *Point Blank*, is that ſpace that the Ball flies in a line ſenſibly right, without any inclination.

The ſecond called the *Mean*, which comprehends all that ſpace the Shot flies in a curved line.

The third, called the *Dead Shot*, which is the fall of the Ball by a ſenſible right line, towards the Center of the World, after that the violence is ceaſed.

The Gunners do take notice of theſe three parts of a Range, for three ſeveral ends.

Thoſe ſhots of *Point Blank* ſerve to batter the Rampires and Walls of Forts and Caſtles.

The middle of the Range or *Mean*, to moleſt a far off the Troups in the Campaigne, and in their Quarters, and to ruine the Houſes within Cities, Caſtles, *&c.*

The *Dead Shots* ſerve for Mortars or Trabucchoes, and Bombes, and other Artificial Fires, to be ſhot upon the Enemy, eſpecially when they cannot be otherways offended, nor ſeen, being covered behind with Ramparts, Trenches, Hills, and other Eminencies.

A ſhot *Point Blank*, which is the moſt ordinary and moſt important, is diſtinguiſhed into two manners, *viz.* in regard of the Horizon, and in regard of the Object which it ſtrikes.

As to the Horizon they are of three ſorts, firſt *Level*, ſecondly from *Low to High*, thirdly from *High to Low*, called *under Metal*.

The Horizontal, and by the Level of the Chase, is the most secure of all the rest.

That from *low to high* proves fallacious, because by the recoyling which the Peece makes, the Shot flies higher than the Mark.

And that from under, or from *high to low*, is most fallacious, because the Shot, besides other notable effects, comes more low by the recoyling of the Peece. Therefore an Experienced Gunner must remedy these faults, by taking the due advantages in shooting.

As to the Object, a shot *Point Blank*, is made either at right Angles against the Superficies of the Object, or at oblique Angles.

At right Angles it strikes more furiously than at oblique Angles, therefore it is used against strong Walls to batter them, and are used to make Batteries *Cameretta*, or Tire by Tire; which is done by discharging all the Peeces of Battery against the self same Mark, and in the same instant, Holding it for a Maxime, *that ten Cannons discharged together, do far more Execution than discharged one after another.*

At oblique Angles, they strike either Cross-ways, or rebounding like a Tennis-ball.

If they strike cross-ways, with two Batteries, one upon each side of the Object, it ruins more speedily the Defence either of Earth or Wall.

If they Batter obliquely, or by a Rebound, which is done when they cannot do it right forward;

forward; as if one would batter a Flank covered with an Orillion or Shoulder, one muſt ſtrike the Curtain in ſo fit a place and obliquely, ſo that by the rebound the Shot may leap into the Flank, holding for a Maxime in this operation, *that the Angles of Incidence and Reflection are equal.*

The *middle* Ranges are divers, according to the divers Elevations of the Artillery.

The *Elevations* are regulated by the Gunners Square, which is an Inſtrument of Braſs, made of two right Lines, one longer than the other, both which makes a right Angle, from which as from the Centre is deſcribed an Arch divided into 90 degrees, or into 12 equal parts called *Points*; and moreover the ſaid Arch exceedeth a Quadrant by 45 degrees or 6 Points, and this Exceſs ſerves for ſhooting below the Horizon as the Quadrant doth for above; and from the Centre hangs a Thread with a Plummet, whoſe Leg being placed in the Chaſe, cutting the Arch, doth ſhew the degrees of Elevation, or Depreſſion. See the *Fig.* 57.

In this *mean* ſhooting one doth obſerve, that always goes fartheſt from the Horizon which hath ſome Elevation, and eſpecially that of moſt points of Elevation, even to 6 points or 45 degrees, which is ſaid to be the greateſt Elevation, which one never exceeds in long Cannons.

The *dead* Shot is that which is commonly worked with the Trabucchi or Mortars, and is

done by giving Elevation from the points 6 or 45 degrees to the points 12 or 90 degrees, which are meaſured by the aboveſaid Square; or with a particular Inſtrument like a Level, putting a Staff a croſs the mouth of the Mortar, and upon that the Quadrant.

In ſhooting in theſe is obſerved, that at the ſixth Point is the fartheſt off, and that at the ſeventh Point comes the neareſt; and that at the eighth nearer, and ſo nearer and nearer to the twelfth Point, in which the Ball falls, in the ſame place from which it departed.

The Last Chapter.

Of the Length of Ranges.

FOraſmuch as the Randoms or Ranges in a Peece of Point blank, and of the greateſt Elevation, is difficult to be known without the Experience of every Point; yet in the War, for the length of every Cannon's ſhot, they generally compute the length of three Muſquet ſhot, which will be from 400, to 450 *Venetian* Geometrical Paces. [a]

[a] *A Geometrical Pace is* 5 *Foot, and the proportion betwixt the Venetian Foot and Ours, is as* 1000 *to* 1153. *Therefore here the proportion will be from* 460 *to* 518 *Engliſh Paces.*

Never-

Nevertheleſs for more particular knowledge, theſe following Meaſures may ſerve, being *Engliſh* Geometrical Paces.

Shots.	*P: Blanke.*	*Greateſt Elevat.*
Smeriglio, Baſe, or Rabonet.	207.	691.
Falconet about 3 l.	322.	1843.
Falcon, about 6 l.	392.	3226.
Sacre, about 10 l.	634.	4032.
Demi-Culvering, about 14 l.	783.	4378.
Colebrina, or Culv. about 30 l.	1382.	5760.
Culvering, about 50 l.	1498.	6106.

Cannons of Battery ſhoot $\frac{1}{3}$ leſs than Culverings of equal Calibre.

But Demi-Cannons and Quarter-Cannons, faſhioned like Culverings, ſhoot little leſs than Culvering of equal Calibre.

Cannons Petrieroes, loaded with Artificial bodies, as Chain-ſhot, Caſe-ſhot, Barrel-ſhot, ſhoot not much farther than a Musket.

Of Shot made out of Mortars and Trabuchoes, betwixt the Middle or Mean ſhot, and the Dead ſhot, is to be obſerved by Experience; thoſe are equal, which are equally removed from the ſixth Point of the Quadrant, *viz.* that the Bombe fall as far diſtant being ſhot from the ſame Peece, and with the ſame ſtrength at the fifth as at the ſeventh Point, and the ſame thing at the fourth as at the eighth, and as much at the third as at the ninth, and ſecond as at the tenth.

Shots from Mortar-peeces are more fallacious, sometimes flying farther, sometimes shorter than needs, and the Bombes break in the Air, sometimes after the Fall they do not break, which gives time to the Enemy to retire, or to choak it; therefore if you would have a just blow, and to take effect, these following Advertisements must be observed.

Advertisements.

1. One ought exactly to know how many Paces are to the place which you would shoot, which may be done with an Instrument.

2. That the Bombes, or other bodies which are to be shot, be of equal weight, otherwise the shots will vary.

3. That the Carriage in breadth may be always upon a Level, and without any Descent, that it do not leap in discharging.

4. That the Powder, with which the Mortar is loaded, be always of the same force and weight.

5. That the Charge of the Mortar, as well in Powder as in Wadding, may be always ramm'd in with blows equally heavy, and of equal number.

6. That the Wadds be always either of Wood, or Tampeons, or else of untwisted Okam, for the strongest drives it fartheſt.

7. That the Fuses be newly made in those days that they are to be used, and that they be made

made of a mixture proportionable to the Range that the Shot ſhall make in the Air, and that it break in the very Fall.

To make the Bombes break in the Fall, the skill is in the Fuſee fill'd with mixture of Compoſition, which is to be ſuch, that although the Bombe fall in the water, it ought to break.

To meaſure a juſt time, is done by filling the Fuſee after the ordinary manner. Moreover take a ſmall Barrel or Cane of Iron, of equal Bore to that of the Fuſe, but ſomething longer, with many little Holes all along its length, and filling it in the ſame manner as the Fuſe. Then the Bombe being fitted in the Mortar, you give fire in the ſame time to the Fuſe in the Mortar and the Iron Barrel, letting the Barrel burn untill that you ſee the Bombe break, in which moment you obſerve the Barrel, and to what hole the Fire burns down, which will give an aſſured mark of the time that the Fuſe ought to have.

If the Bombe in the very Fall ſhall break, the ſame quantity of Compoſition ſhall be continued in the Fuſe; but if it break before the Fall, you muſt abate the heat, by adding a ſmall mixture of Charcoal-duſt incorporated in the ſame compoſition: and if after its Fall it ſhall delay its effect, then you ſhall joyn with its mixture a little fine Powder-duſt. And ſo you may by experience with this Barrel obſerve unto what marke or hole it burns; ſo that with ſuch Fuſes the Bombe ſhall juſtly break in

the very Fall amongst the Enemies; afterwards observing always to fill the said Barrel with the first Mixture.

Being necessitated to use an Okam Wadd in lieu of a Tampeon, as was first used, so the Load of the Mortar shall be augmented to such a proportion, that the Bombe may carry to the same place, as it did when it was loaded and stopt with a Tampeon, or if it shall require another Elevation.

A Table for the several Randoms to each degree of the Quadrant, the greatest equal to 10000.

Deg. of Elev.		*Elev.*	*Elev.*		*Elev.*
1	349	89	26	7880	64
2	698	88	27	8090	63
3	1045	87	28	8290	62
4	1392	86	29	8480	61
5	1736	85	30	8660	60
6	2079	84	31	8829	59
7	2419	83	32	8988	58
8	2756	82	33	9135	57
9	3090	81	34	9272	56
10	3420	80	35	9397	55
11	3746	79	36	9511	54
12	4067	78	37	9613	53
13	4384	77	38	9703	52
14	4695	76	39	9781	51
15	5000	75	40	9848	50
16	5299	74	41	9903	49
17	5592	73	42	9945	48
18	5870	72	43	9976	47
19	6157	71	44	9994	46
20	6428	70	45	10000	45
21	6691	69			
22	6947	68			
23	7193	67			
24	7431	66			
25	7660	65			

The Uſe of the Table before ſet down.

To ſee the different Randoms cauſed by the different Wadds of Okam and Wood, I have made the Experiment in Mortars and Bombes of 1001 weight in a plain field, which loaded equally and weighing each 551, and the Chamber loaded with fine Powder of five, one, & one, 20 *onz.* and the Chamber ſtopped with a Tampeon of Wood, and with the Elevation of the Mortar to 45 degrees. I ſay to the point of the Quadrant 6, the Bombe fell diſtant 600 Geometrical Paces. [a] a 691 *Engliſh Paces.*

Then with the ſame Mortar, Load, Bombe, and Elevation, but with an Okam Wadd in ſtead of a Tampeon, the Bombe fell onely diſtant 480 [b] Geometrical Paces. b 553 *Engliſh Paces.*

For theſe two different, and all other Randoms the aforeſaid Table will ſerve; in which one may ſee the Proportion each Shot ſhall make, with the Elevation of degree to degree, interpoſing the proportional Numbers, with which and with the help of the Golden Number, or *Rule of Three*, one may find what ſhall be the Random made in this or any other Mortar, at any Elevation, at 45 degrees, or any other degree being firſt known.

Example I.

Let it be propounded, that a Mortar of 300 with a Tampeon of Wood, and Elevation of 45 degrees, or Points of the Quadrnt 6, carry

a

a Ball 800 Paces; if one would know with the ſame Charge how many Paces it will ſhoot at the Elevation of 54 degrees.

See then, that at the ſaid 54 degrees of the Table correſponds the proportional Numb. 9511, and at the aboveſaid Elevation of 45°, or points of the Quadrant 6, correſponds the proportional Number 10000, which by the Golden Rule is ſo worked.

If 10000 gives me 800, ſo 9511 gives me the number of Paces which is required.

Thus I Multiply 9511 by 800, and Divide the Product by 10000, the Quotient will be 760, which are the Paces that the Mortar will ſhoot the Ball, with the Elevation of 54 degrees.

Example II.

Let it be granted or ſuppoſed, that a Mortar of 300, at the Elevation of 54 degrees, ſhoots the Bombe 760 Paces; if one ſhould deſire to know what Elevation one ought to give to the ſame to ſhoot the Bombe 550 Paces, you muſt work by the Golden Rule in this manner.

As 760 Paces give the Number proportional 9510, ſo 550 Paces will give its proportional Number.

Wherefore if you multiply the ſecond 9510 by the third 550, and dividing the Product by the firſt 760, the Quotient will be 6882, which Number, if you ſeek it amongſt the proportional Numbers in the Tables, and not finding it juſt, if you take its neareſt, it ſhall be the number 6947, to which correſponds the degrees 68, which

which ſhall be the Elevation, and which ought to be given to the Mortar of 300, to fall in the diſtance of 550 Paces, with the ſame Charge of the firſt, and that is as much as I eſteem neceſſary for every Soldier as well as for a Gunner, who intends to be ſerviceable for his Prince and Countrey.

Of the Petarr.

A *Petarr*, is a Machine in form of a Mortar, which being loaded with Powder, and placed with its Mouth againſt Gates, or other wooden Engines, and giving fire, breaks and ruins them.

This Inſtrument was firſt invented by a Thief, or Robber, being firſt made of Wood, and bound about with Iron, not onely againſt Houſes, but alſo to enter into Towns; which being obſerved to work admirable effects, it was afterwards put into Execution by Princes againſt the Cities of their Enemies: and to give them greater Force, they made theſe Petarrs of Iron, but afterwards finding them too brittle, they were made of Braſs, as they are now in uſe.

The Subſtance of which the Petard is made of, is an Union or commixture of Copper, *Engliſh* Tin, and Latten well refined. Some do vary both in proportion, and alſo in the Metal, ſince that ſome would have them all of beaten Copper,

Copper, without any other mixture: others to every 50l of Brass, 5l of Tin, and two of Latten. Others to every 10l of Brass one of Latten.

The Copper therefore is soft, the Tin gives it hardness, but if it be overmuch it makes it brittle; they would have the Latten mixed with the Copper and Tin together.

The Proportions for the Petarr.

THe *Guide-line* is divided into 24 equal parts, of which 16 is the Diameter of the Mouth.

The Diameter of the Concave at the Bottom, 10.

The Thickness of the Metal at the Breech, 2.

The Thickness of the Metal at the Mouth, 1.

The Cornice is one part. 1.

The Touch-hole is distant from the bottom of the *Guide*, part. 8.

Some make it perpendicular to the *Guide*, and others perpendicular to the Metal; but as well in the one as other fashion, it is terminated in the said point of the *Guide*.

Some soder or fasten the said little Barrel or *Canetta*, and others make it to enter with a Screw; the Joynting or Mortaising of the Mouth is part $\frac{1}{2}$.

The Greatness of the Petarr is divers, according to the diversity of Matters which it ought to break, but all have the self same Proportion above named.

To

To break down Bridges they are long in the *Guide* a Gometrical Foot, which is commonly divided into 12 Inches. [a]

2. To break double Bridges they are high in the *Guida* 11 Inches. [b]

3. To break ordinary Bridges reasonable strong, you must allow in the *Guida* 8 Inches.

4. To break Barriers, Grates, Portcullis, Pallizadoes, they are made high 11 Inches.

They load a Petarr with the finest Powder that can be made, well sifted and dusted. They do not fill the whole, but only $\frac{3}{4}$ of its length, and ramme the Powder in from time to time to make it close, but not so strongly as to uncorn it.

The Powder, which is put within shall be of weight, for the

First subtle Pound from	9	to 10.
For the second from	6	to 7.
For the third from	5	to 7.
For the Fourth from	3	to 4.

Above the Powder they put a round piece of Past-board thick, and stops it an Inch about, and above that they cast Pitch and Wax melted together, but not over-hot, and above which you put a round piece of Wood well fitted, and above all a round piece of Cloth waxed, which is driven into the Joynt, or is tied without with a Cord about the Edge, and all this that it may not receive water or moisture.

The Touch-hole is made near the bottom, but better than a third part distant from it; because

a *Which is almost* 14 *Inches Engl.*

b 12 *Inches Engl.*

cause the Powder will be sooner fired, and the Recoyl will be greater.

In the Touch-hole they fix a Spindle or little prick of Metal to a Screw, which penetrates to the middle of the Powder; and this is filled with Composition for a time, that the Petarr-Master, and his Company may have time to retreat, and secure themselves, and may resist water.

So you may take fine Powder 3 parts.
Sulphur——6.
Saltpetre——9.

All these Ingredients being stamped and mingled, putting above oyl of Stone by little and little, so that they may impast together, and letting them well dry in the Sun. Then load the Fuse, or take Powder 2 *onz.* Sulf. 2 *onz.* Saltpetre 3 *onz.* Camfire 1 *onz.* $\frac{1}{2}$ beaten small, and fill the Fuse.

To the Petarr there are one or more Handles for to fasten the Madrill, although the *Orl* or Edge serve to nail it about.

The *Madrillo* is a strong beam of wood of Elm or Oak, shod with Iron, which is placed before the Mouth of the Petarr, and fastned to the Gate which you would break, to make greater ruine. For every Petarr the Madrill is long B 3 of its Petard, measured and comprehending the Edge, and large 2 of the B.

The thickness is ordinarily of four Inches more or less, according to the strength that you are to batter.

Cross

Croſs to the Madrillo there are two bars of Iron Diagonally let into the wood, each being thick $\frac{1}{4}$ of an Inch, nailed to it.

The Madrill with the Petard is faſtned to the Gate in ſeveral manners, according to the nature of the thing which you intend to ruine, ſince that the Gate may have a Ditch, or if not, it may be well lined with Iron, or not at all.

Therefore if it have a Ditch, it muſt be hung on with a ſmall Bridge; but if it is without Ditch, or ſtrengthned with Iron, it may be faſtned with a Plank; or if armed with a Fork or Reſt, and in other particular manners, which would be too long further to explain.

THE END OF THE PETARD.

Advice

Advice for Ship-Gunners, out of Furnier's *Hydrography, p. 95.*

Of Canoneers necessary for the security of a Ship.

BEfore *Cannon* was invented, they did use both at Sea and Land certain Machines which did throw Fire, Arrows, Stones, and Beams of Wood, which did as much dammage to the Enemy as our Cannon, but were not so easie to be governed. We do not know what were those Engines that *Archimedes* did use for the Defence of *Syracuse*, onely we are certain, that he had those which did cast great Stones a vast distance, and as *Plutarch* observes, with Smoak, and a great Noise, and that he had Burning-glasses which did burn at indeterminated distances.

In the Advice, which in times past the Emperour *Leon* gave to his Admirals and Sea-Captains, in several places he makes mention of Engines which did vomit fire and flames in close fights, and Sea Combats. And the *Roman* History doth relate, that *Mithridates* besieging *Rhodes* by Sea, after he had made a breach did great

great dammage to the Beſieged by the means of a Sambuque or warlick Inſtrument of Prodigious greatneſs, which being placed upon two Gallies, caſt forth at one blow great number of Arrows, Stones, and Beliers, being ſquare pieces of Timber pointed with Iron at both ends. All theſe Engines being very incommodious and troubleſome, by reaſon of their bigneſs, and requiring over great a Train: at preſent they uſe nothing but Cannon, therefore I ſhall only ſpeak here of this Machine, and only as much as ſhall be neceſſary for its well mannagement at Sea, or perhaps ſometimes to make a Deſcent or Landing; judging it neceſſary not to omit this Treatiſe, ſince at preſent all the defence of a Veſſel depends on the Cannon, and that in the time of fight there are more Shots made in one day at Sea, than in a Seige at land in two months.

The arming of a Gally is much different from that of a Ship or round Veſſel, as alſo the Equipage of Cannon at Sea differs from that at Land; at Sea the Ordnance are mounted upon ſmall Carriages, and upon four and ſometimes two low Wheels, without any Iron work. Each Gally carries ordinarily nine Peeces of Ordnance in its Prow or Chaſe, of which the greateſt, and that which delivers his Shot juſt over the very Stem, and lies juſt in the middle, is called the *Corſiere*, or *Cannon of Courſe*, or *Chaſe Cannon*, which in time of fight doth the moſt effectual Service, it carries generally a Shot of

33 l or 34 l weight, and are generally very long Peeces; it recoils all along the middle of the Gally to the Maſt, where they place ſome ſoft ſubſtance to hinder its farther recoyl, that it might not endammage the Maſt. Next to this *Corſiere* are placed two *Minions* on each ſide, which carries a 5 or 6 pound Ball; and next to theſe are the *Petrieroes*, which are loaded with Stone-ſhot to ſhoot neer at hand. Thirdly, there are ſome ſmall Peeces, which are open at the breech, and called *Petrieroes a Braga*, and are charged with a moveable Chamber loaded with baſe and bar-ſhot, to murder near at hand. And the furtheſt from the Corſiere or Chaſe-Cannon are the *Harquebuſs a croc*, which are charged with ſmall Croſs-bar ſhot, to cut Sails and Rigging. All theſe ſmall Peeces are mounted on ſtrong pins of Irons having Rings, in which are placed the Trunnions with a Socket, ſo that they are eaſily turned to any quarter.

In Ships or round Veſſels are ſometimes mounted 200 Peeces of Ordnance, although at preſent, experience ſhews that 100 are ſufficient for the greateſt Ships, Carraques or Gallions, it being impoſſible to have a greater number, giving a juſt diſtance betwixt each Cannon, that there may be room for men to ply the Guns, and that the fire of one may not endanger to give fire to the other.

All the Guns are mounted upon Wheels and Carriages; moreover the Petrieroes, which are planted in the Forecaſtle and Quarter to defend

defend the Prow and Stern, are mounted upon ſtrong Pins of Iron without any Reverſe; the greateſt Peeces of Battery are planted the loweſt, juſt above the ſurface of the water, the ſmalleſt in the Waſt and Steerage, and with the Petrieroes in Quarter-deck and Forecaſtle. Upon the Sea, to load great Ordnance they never load with a Ladle, but make uſe of Cartridges, as well for Expedition as Security in not firing the Powder, which in time of fight is in a continual motion.

The Qualifications of him who takes the charge of the Cannon of a Ship.

THe *Gunner*, whom they call in the *Straights Captain*, *Maſter-Canoneer*, and in *Bretagne* and *Spain* and in other places *Conneſtable*, is one of the principal Officers in the Ship; it is he alone with the Captain who can command the Gunners. He ought to be a man of courage, experience, and vigilant, who knows the goodneſs of a Peece of Ordnance, the force of Powder, and who alſo knows to mount a Peece of Ordnance upon its Carriage, and to furniſh it with Bolts, Plates, Hooks, Capſquares, Axletrees, and Trucks, and that may not reverſe too much; to order well its Cordage as Breeching and Tackling; to plant the Cannon to purpoſe in the middle of its Port, to know how to unclow it, make ready his Cartridges, and to have

them ready to pass from hand to hand through the Hatches, and to employ his most carefull men in that affair; that he have care of all, that he be ready every where to assist where necessity shall be; and take care that all be made to purpose.

He and his Companions ought with their dark Lanthornes continually to see if the Guns play, and if the Rings in Ships do not shake.

If there be necessity of more Cordage, and to see that the Beds and Coins be firm and in good order; when the Ship comes to Anker, he furnisheth Cordage, and takes care that all his Companions take their turn and quarters, that continually every evening they renew their priming Powder, and all are obliged to visit their Cannon Powder every eight dayes, to see if it hath not receiv'd wet, although they be well stopped a top with Cork and Tallow; to see that the Powder-room be kept neat and clean, and the Cartridges ranged in good order, each nature or Calibre by it self, and marked above in great Letters the weight of the Powder and nature of the Peece to which it belongs, and to put the same mark over the Port-hole of the Peece; that the Linstocks be ready, and furnished with Match, and to have alwaies one lighted, and where the Cannoneer makes his Quarter to have two one above another below; that his Granadoes and Firepots be in readiness, and 3 or 400 Cartridges ready fill'd, Extrees and Trucks, to turn often over the Pow-

Powder-barrels, that the Powder do not *ſpoil*; *to have a care of Rings and of the Ports, that they have their Pins and ſmall Rings.*

Although every man ought to be a man well approved and experienced in all theſe things, before he can be truſted with the charge of a Veſſel, which depends in time of fight more upon him than any other; nevertheleſs thoſe who aſpire to the charge of a Maſter Cannoneer, ought to have the Theorick and Practick part joyned together, as well to practiſe themſelves, as to inſtruct and correct the faults of their Undergunners, and moreover to teach them all ſorts of Fireworks, which may ſerve as occaſion ſhall require. The Sub-gunners and Matroſſes ought to be ſo many, that each may have no more than two Guns to his charge. And for as much as one finds at Sea very few perſons who underſtand all that I intend to ſpeak of, and thoſe who underſtand very often cannot inform, or elſe will not take the pains to inſtruct their Companions, and the Matroſſe, who ſerve under them, therefore I will prolong this following Chapter, of that which I have in general touched here.

At Sea they never uſe the Ladle but Cartridges, of Canvas or Parchment, to which they give three Calibres in breadth, and four in length, and two half Calibres for the lying, in caſe there is no Scrole, and before they put the Cartridge into the Chaſe, they open that end towards the Touch-hole with a Knife or Priming

ming Iron upon that part which corresponds to the Touch-hole. If the Cartridge is well made there is no need of ramming it after the Charge.

If with a Cannon or Pierrier you would shoot a Bullet red hot, before you put it into the Chase betwixt the Powder, in stead of Hay or Wadding you must put a Sod of Earth, and spunge well the Cannon.

To lay a Peece of Ordance to pass at Sea.

TO point a Peece of Ordnance, or lay a Peece to pass, is to level it directly against the Mark you intend to strike.

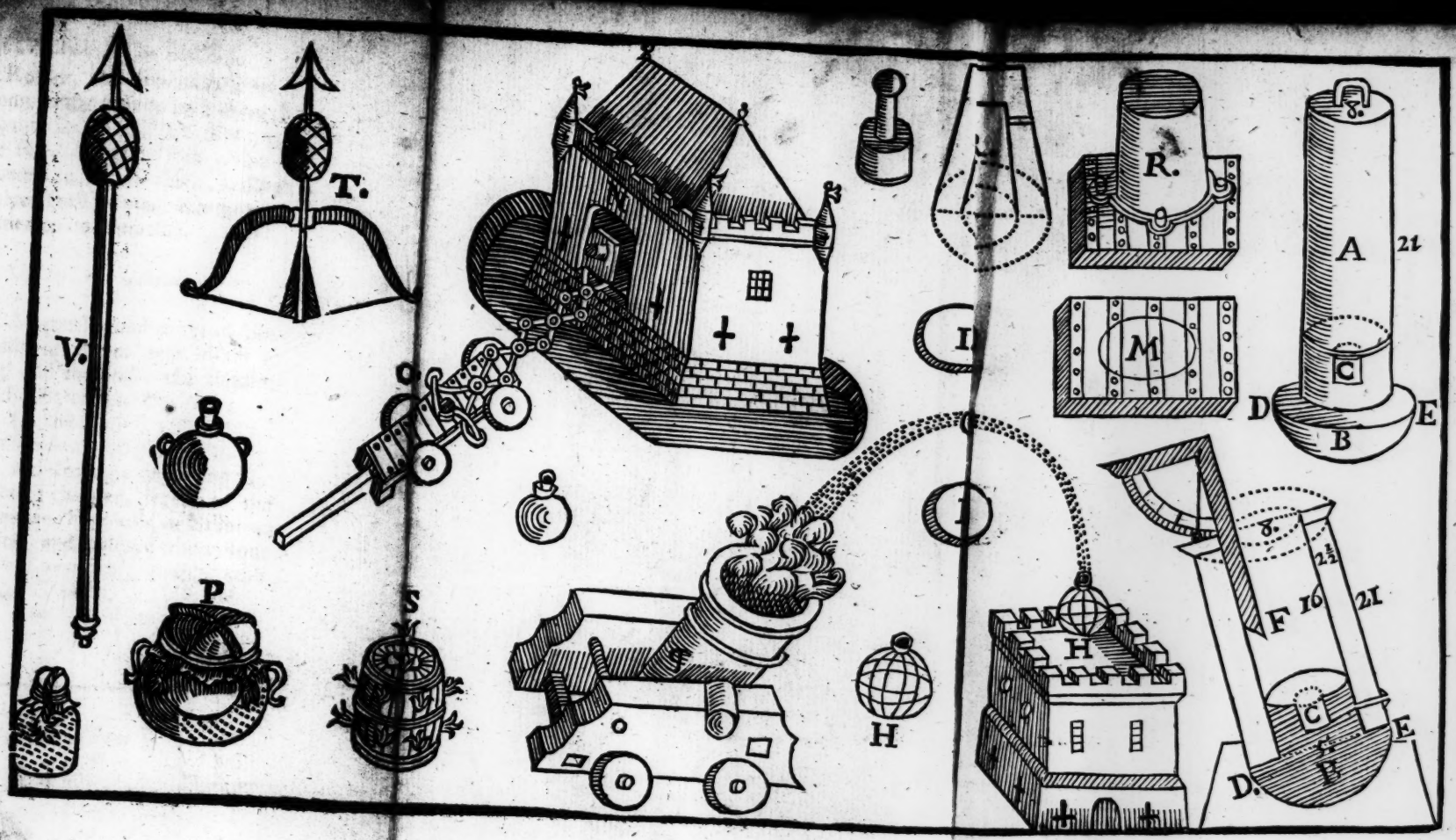
The practise whereof which they use at Sea, is different from that of the Batteries at Land. For at Sea all the exactness of Shot depends upon the motion of the Ship; when you give fire, the Heaving of the Ship, and setting of the Waves, are ordinarily so inconstant, that if the Cannoneer doth not well observe his time, he misseth his Aim, and faileth his Shot, and which depends wholly upon his judgment, having no other way to guide himself then this, which is so well to take time, that he expect and see that part the most elevated and raised up upon the water which he intends to strike, that it may not be covered and under water at such time as the Powder takes fire, and chaseth the Ball, which may happen in several manners, to wit, If we give fire when one of the Vessels ingaging

gaging or ingaged ſinketh it ſelf into the hollow of the Waves, then when that from whence you intend to ſhoot abaſeth or raiſeth its Deck on which is your Battery, your Peece then loſing its Horizontal Line, or when the Waves which are betwixt the Enemies Ships ſwell up and cover your Battery, Judgment only and Experience can put this Advice into practice. Thoſe that will apprehend, muſt firſt know the thickneſs of the Metal at the Touch-hole, and from thence judge the time that the Powder may be a firing to the Chamber. Secondly, they muſt well adviſe themſelves of the diſtance of moving of the Object againſt which they aim, which ought to be no farther diſtant than 1000 common Paces or more, and then they level the Peece about 20 Paces before, in which time the Veſſel overtakes the determinated diſtance, in the mean time that the Powder in the Touchole burns, and that the Shot flies. Thirdly, they muſt diligently obſerve the roling and motion of the Veſſel, according to which they make tryal of their Judgment.

An Appendix of Artificial Fire-works for War and Delight ; by Sir Abriham Dager *Kt. Ingeniere.*

First of an Artificial Mortar made of Wood, Canvas and Paſte-board.

I ſhall not make mention here of any Mettal Mortars, ſince they are plainly treated of in the fore-part of this book, but only ſhow you how to make an artificial Mortar: you muſt get a Rouler A. of 8 inches in diameter, and 21 in length, then get a foot B. turn for the Brith of the ſaid Mortar, of the ſame diameter as the Rouler, obſerving that the head D B E be of 13 inches in diameter, and 5 in the thickneſs B; then make a hole or Chamber in the Brith for the Powder, having 2 inches in diameter and three in depth, them two pieces muſt be joyned together by the ends as it is repreſented, and after you have well rubbed your long Rouler with Tallow for fear the Glue ſhould ſtick upon it, roul upon the ſame ſome Canvas or Cotton Cloth, and Paſt-bord well wetted all over with Glue, the thickneſs of 2 inches or $2\frac{1}{2}$, then let it dry being well faſten'd round about with Cord wetted in Glue; and having pull'd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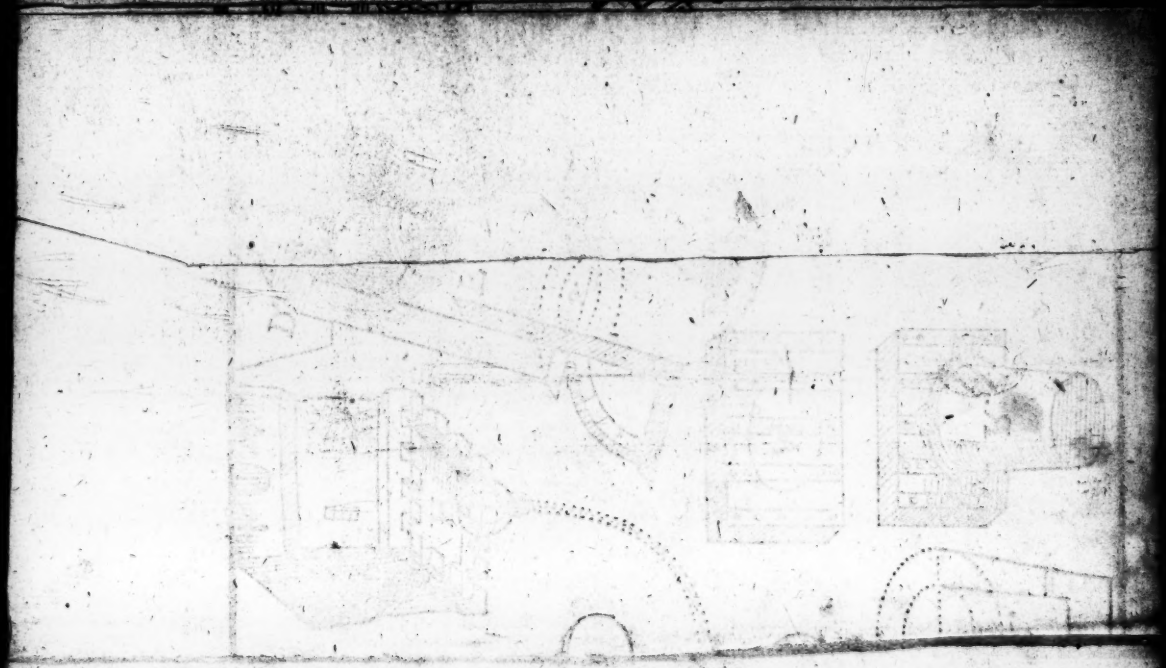

pull'd out the Rouler, and droven ſome nails of 4 inches long in the foot to joyn them together, as you may ſee by F D B E, then make a hole for the fuſe, and get a foot of wood 24 inches ſquare, 10 inches thick, and 7 in depth, where you ſhall ſet your Mortar upon its Brith in order to its operation.

The Uſe of the Mortar.

This kind of Mortar is good to throw Granadoes, Fire-balls or Stones over Walls or into a Garriſon; and to hinder the Enemies works, as Trench, Batteries, *&c.*

This Mortar (as the others) riſeth to any degree of the compaſs as you pleaſe, from 40 degrees to 45, and from 45 to 90 degrees. After your Mortar is charged, ſet fire to the fuſee of the Granado, Fire-balls, or Balloons, then to the Mortar, and obſerve where your Granado falls, and according correct your faults the following Shots.

Degrees of Proportion of the Compass, for the use of the Mortar.

Degrees.	Distance.	Degrees.	Distance.	Degrees.	Distance.
90	0	75	403	60	661
89	80	74	425	59	673
88	124	73	448	58	993
87	148	72	450	57	708
86	171	71	473	56	723
85	195	70	496	55	737
84	219	69	500	54	751
83	243	68	521	53	765
82	267	67	540	52	779
81	289	66	562	51	792
80	291	65	580	50	804
79	313	64	599	49	816
78	335	63	608	48	827
77	359	62	626	47	838
76	381	61	644	46	848

Fire-Balls of Canvas.

TAke a round cloth ball filled with Sand, of such bigness as you desire make your Fire-balls, upon which you shall shape your Canvas, and after it is finished, you shall let out

out the Sand and take out the Linnen ball; after which, you ſhall ſow it up, and fill it with this following Compoſition.

Take Saltpeter, Powder, Sulphur, of each equal quantity well pounded, and mixt together with as much Linſeed Oyl as to make it in a kind of a Paſte, which will be to fill your Balls.

Another Sort.

Take Saltpeter, Powder, Sulphur, Camphire and Borax, all well pounded in a Mortar with oyl of Piter, and diſſolve in black Pitch, Wax, Colophone, and Mutton tallow, all theſe things muſt be well boiled together; then make up your Balls, and cover them with Tow, having made two holes with a Bodkin croſs-ways, which you ſhall fill with prime of a ſlow compoſition, that they may have time to take fire: they are good to ſtick and ſet any thing on fire, and other things neceſſary.

Another.

Take one part of Powder, one of Saltpeter refined, one of Sulphur refined, Roſin, Burgundy Pitch, Verniſh in grain, Salt Armoniack, add to every pound 4 ounces of Camphire, and as much Linſeed oyl or Wallnut, and mix it together; note to warm your oyl a little before you mix it together, then make up your Balls.

For the Petard.

THe beſt are made of Copper with the 10*th.* part of Braſs, (though many are made of Iron) they muſt be 12 inches long, the Diameter near the Brith 7½: and in the mouth 10 inches. Fig. R.

After the Chamber is fill'd with Powder, you muſt ſtop the hole with a round piece of Lether I, and afterwards with a wooden one L, that muſt go ſtrait in, and after fill the reſt with yellow Wax or Pitch cover'd over with a Cere cloth, then tye him upon his Madrier M, thus faſtened at the door of the Fortreſs N, his fuſe being full of a ſlow compoſition, that the man fixing it may have time to withdraw, having tyed 2 ſcrews (that muſt faſten him at the door) to the two corners of the ſaid Petard, and to carry and keep him up; you muſt ſet him upon the Chariot O, having 2 ſharp iron points to enter in, and ſtrong enough to bear the ſaid Petard, and a man whilſt he maketh it faſt at the ſaid Door. See Fig. O and N.

Of the Fuſe for Bombes.

THey muſt be of a ſlow compoſition, to give time enough to throw either Bombes, Granadoes, Fire-balls, Thundring Barrels, *&c* They are made thus; take a pound of Powder, four

four ounces of Saltpeter, one ounce of Sulphur well beaten, dry, and ſifted ſeparately; then mix it, and make up your fuſe of it.

Another.

Take Powder of Benjamin, and ſmall Coals all well beaten and mixt together, with ſome oyl of Piter, then uſe it.

How to make Fire Pots. Fig. P.

TAke a Granado charged as they are uſually, only without a fuſe, then put it in an Earthen Pot, filled with fine Powder, and cover with Leather, having 2 Matches croſs ways lighted, with a handle of cord to throw it more eaſily; when it falls, the Pot will break, and the matches ſet the Powder on fire; the Granado will have its effect.

How to ſet fire to any place.

YOu muſt have Bullets that holds 4 or 5 pounds of Powder, and after they are well ſtopt, tye to it ſome Matches lighted, and they will ſet on fire any place, whereever they break.

How to make a Light.

TAke little Faggots made of ſmall dry rods, dipt in black Pitch, new Wax and Colophone

phone melted together; they are good to set fire to Galerys, Paliſadoes, &c. and to lighten.

Of Thundring Barrels. Fig. S.

THeſe Barrels are of a great uſe to throw in at a Breach, or tumble in the Enemies Lodgements; for being of a combuſtible matter, they will ſet fire at any thing that they uſe to ſhelter themſelves; they are made ſeveral ways, ſome as ordinary Barrels and half Barrels, fill'd up with Tow, dipt in ſome Colophone, Turpentine, Pitch, Oyl of Piter, or any thing combuſtible, with Granadoes, Fire pots, Piſtol barrels loaden with Bullets, and ſet ſo that they may not fire all at once, but ſcatter round about them.

Of Thundring Bullets.

THey are made of the following compoſition, in which the Granadoes and Piſtol Barrels loaden with Bullets, are ſet in order with whole Gun-powder betwixt each; and to hinder their firing all at once, you muſt put between them ſome Tow dipt and mixt in the following compoſition; 4 parts Turpentine, 2 of Powder, 2 of Small coals well ſifted, 3 of Poyligui, one of Roſin, one of Camphire, ½ of ſtinking Benjamin, and ½ of Colophone, well mixt all together, and put into your Bullets, as it is ſaid before, not forgetting to bore in

in it 2 or 3 holes filled with prime of a ſlow compoſition, which muſt be lighted before you put it in the Mortar: this Bullet will make a wonderful effect where it falls.

Of Artificial Fire-works uſeful both by Land and Sea.

Firſt of all of fire Lances, ſome are made four and five foot long, ſome of 3, and ſome of leſs, having a Belly near to the iron, which you ſhall fill with the following compoſition. Take ſome Tow dipt in a pound of new Wax and equal quantity of Turpentine, ½ of Powder, as much Sulphur, ½ of black Pitch, all this well melted in oyl of Piter; theſe great Lances are good to ſet fire to a ſhip, the others are thrown with the hand, and the leaſt are ſhot out of a Bow to ſet the Sails on fire, to defend a Breach, or to ſet any things on fire. *Fig.* T.

How to Contrive Artificial Fire Pikes. Fig. V.

They are good to defend the approach of an Enemies Ship, their lengths muſt be from 12 to 15 Foot long, having a belly near the end filled with the following compoſition; one part Saltpeter, as much Turpentine, the ſame quantity of Bay ſalt, 20 parts of Powder well pounded, 3 of Colophone, 7 of Arſnick, ½ of Pitch, one part of Linſeed Oyl, one of Sulphur, mixt all together with ſome Linſeed Oyl

Oyl and Tallow; then make up your work about 3 inches long and one and an half thick.

How to prepare your Cotton for Prime.

TAke some Cotton Thread and double it 4 or 5 times, if you intend it for to prime your stars, but if you intend it for your Lances or Rockets it must be 8 or 10 doubles, then wet it well in clean water, then take powder well beaten, and clear water, and make a Paste, and having squeesed the water out of the Cotton, dip it very well in the said Paste, then take it out, and roul it well in dry powder dust, and set up to dry, for your use.

Of Artificial Fire-works for delight.

THese Fires are divided into three parts, first them that flye in the air; 2*dly*. Them upon the ground; and 3*dly*, Them that swim upon the waters.

And every of these parts is divided also into three parts; the first and most royal for the air are the Balloons, the 2*d*. are the Rockets, and the 3*d*. the flying Saucissons.

Them upon the Earth are also divided into three parts; 1*st*. are the Rockets, 2*d*. Fire Lances, 3*d*. the Saucissons.

Them for the Waters are also three sorts; 1*st*. the Globes or Balloons, 2*d*, the double Rockets, and 3*d*. the single Rockets; but before

fore we ſpeak of their contrivances, I ſhall treat a little of their Moulds and Tools.

Of the Proportions for the Moulds of Sky Rockets.

IF the Mould hath one inch in the mouth, it muſt have ſix in length, and the Rowler for the Coffin ⅓ of an inch in Diameter, but the Rammers D muſt be a little leſs, to go eaſily in the Coffin, having a hole bored juſt in the middle for the Broach C, the foot where it is faſt muſt enter in the Mould one inch and an half, the Broach muſt be 3 Lignes thick, and 3 inches ½ long; if you deſire a bigger mould, you muſt obſerve the proportions according to this Rule.

A is the mould, B the Rowler, F the Bodkin to bore the Rockets and Stars, G the Coffin

The Mould for ground Rockets.

HIs mould muſt have ½ an inch diameter in the mouth, and 5 ½ in length, the Rouler for the Coffin 4 Lignes in diameter, which maketh ⅓ of half an inch, and the Rammer a little leſs; the Broach muſt be ⅓ of an inch long, the Brith going into the mould half an inch.

Of the Mould for Water Rockets.

IF the mouth be one inch in diameter, the length muſt be 8 inches, the brith or foot going in the Mould one inch, but without Broach

Broach; the Rouler muſt have ¼ of an inch in Diameter, and the Rammer a little leſs.

The Compoſition for Sky Rockets.

IF you deſire to have your Rockets mount up with impetuoſity, take only your great Canon Powder well pounded and ſifted, and charge your Rockets as it is ſaid hereafter.

Another.

Take a pound of your great Canon Powder well ſifted, add to it two ounces of ſmall coal duſt well ſifted and mixt together; but before you finiſh your Rockets try one, and if your compoſition is too weak, add ſome powder, if too ſtrong, ſome coal duſt, and for want of Willow Coals, you may uſe of wine aſhes or ſea-coals.

How to charge your Rockets.

FIrſt you muſt take care not to put too much compoſition at a time, but about a Spoonfull at once, giving every time three or four good blows with a hammer of a pound weight, continuing ſo till your Coffin is full to the Moulds mouth, or very near, then thruſt hard upon it ſome paper doubled ſeveral times, or elſe a round piece of Paſte-board bored three or four times with a Bodkin to give fire to your Stars, Serpents, or Saucilons, then cut the

the remainder of the Coffin as close as you can, and cover the rest with Paper well glued.

The Composition for the Ground Rockets.

TAke some Gun-powder without any mixture, well sifted, and fill your Rocket with it (as it is said before) within an inch of the Moulds mouth, then thrust in hard a piece of Paste-board or double Paper, bore in it some holes with the Bodkin, and then put in it a good Pistol charge of whole Gun-powder, and having doubled some Paper of the Coffin upon the said powder, choak the rest very well, and cut what remains.

Of the Composition for Water Rockets.

TO make her appear with a great Tail, take Saltpeter one pound, Powder half a pound, Sulphur half a pound, Coal dust, two ounces, all well sifted and mixt together, and fill up your Rockets the same manner as the other; and having put a Sauciffon at the end, cover it with Paper, and cover the Rocket all over with black Pitch and Rosin, to make it swim, and hinder the water from spoiling it: then tye to it a little Willow Rod of about two foot long, and if you desire to make them leap in and out of the water, you must put, in charging the said Rocket between every two fingers breadth of the composition ‡ of an inch of fine Powder well sifted.

How

How to make Serpents. Fig. 1.

TAke a Rouler a little bigger then a Goose quill, and roul some Paper upon it, eight or ten times, making your Coffin of about four inches long, then choak it near the middle, leaving a little light to communiguate the fire, then fill part with composition, and the shortest with whole Gun-powder; then choak both ends, the end towards the Powder quite up, and the other with a little hole for the prime. The composition for Ground Rocket is the best for Serpents, the other composition for Sky Rockets being not so brisk, nevertheless both will do good effect, and leap about very prettily.

How to make Gold Rain. Fig. 2.

TAke a quantity of Goose quills, cut the hollow end as long as you can, and fill them a little hard with the composition for Sky Rockets; then prime them with wet Powder, and keep them for your use.

How to make Silver Rain.

TAke one part Camphire, 8 of Powder, 12 of Sulphur, 24 of Saltpeter, well beaten together, wetting the Pestle with oyl of Almonds; then fill your quills as before, taking care that the air do not spoil it.

There

There are several sorts of Stars, the red ones are made as followeth.

TAke a pound of Saltpeter, ½ of a pound of Sulphur, ¼ of a pound of Powder, all well sifted and mixt together; then roul that composition in Linen or Paper about the bigness of a Nutmeg, making a hole through with a Bodkin, to prime it with the prepared Cotton. See 3, 4, 5, 6.

Another.

Take a pound of Saltpeter, ½ pound of Sulphur, ¼ pound of Powder, all well sifted and mixt together, then take some Linseed Oyl, or clear Water, and make a hard paste made up in little Balls, roul them in Powder dust whilst they are wet, and after they be dryed, they are fit for your use.

Another of Blew and Red.

TAke Saltpeter 4 ounces, Sulphur, 2 ounces, Meal 8 ounces, Powder 2 ounces, all well sifted and mixt together with oyl of Spike.

Another of White.

TAke Powder eight ounces, Saltpeter 24, Sulphur 12, Camphire one, beaten well together with Oyl of Almonds, and keep it close for fear of taking air.

Another White one that lasteth long.

Take Powder 4 ounces, Saltpeter 16, Sulphur 8, Camphire one, Oyl of Piter 2.

For

For Fire Lances.

THe Coffin muſt be as the others, of ſuch bigneſs and length as you deſire, then fill it with the compoſition for red Stars, the lower end muſt be ſtopt with a piece of wood of about two inches to nail them faſt, and the upper end prime with wet powder.

How to make the Balloons. Fig. 7.

YOu muſt get a Rouler turned of ſuch bigneſs as you deſire to make the Moulds of the Balloons, then roul upon it ſome Paſteboard, not ſparing the glue to make it faſt; and having made your great Coffin, you muſt choak it at one end, and fill it with Sauciſſons, Serpents, Stars, *&c.* in good order, and well prime that when the Powder Chamber at the bottom taketh fire, and breaketh the Balloons, they may all take fire at once, then choak the other end, leaving a hole big enough for a fuſſe, that you ſhall glue to it, fill'd with compoſition able to light the prime, and make the Balloon to play with order and effect.

How to make Fire Wheels. Fig. 8.

TAke a Wheel of bigneſs according as you intend to make your fire, and having put your Rockets in order, ſo that when one ends, it may give fire to the next, and ſo continue.

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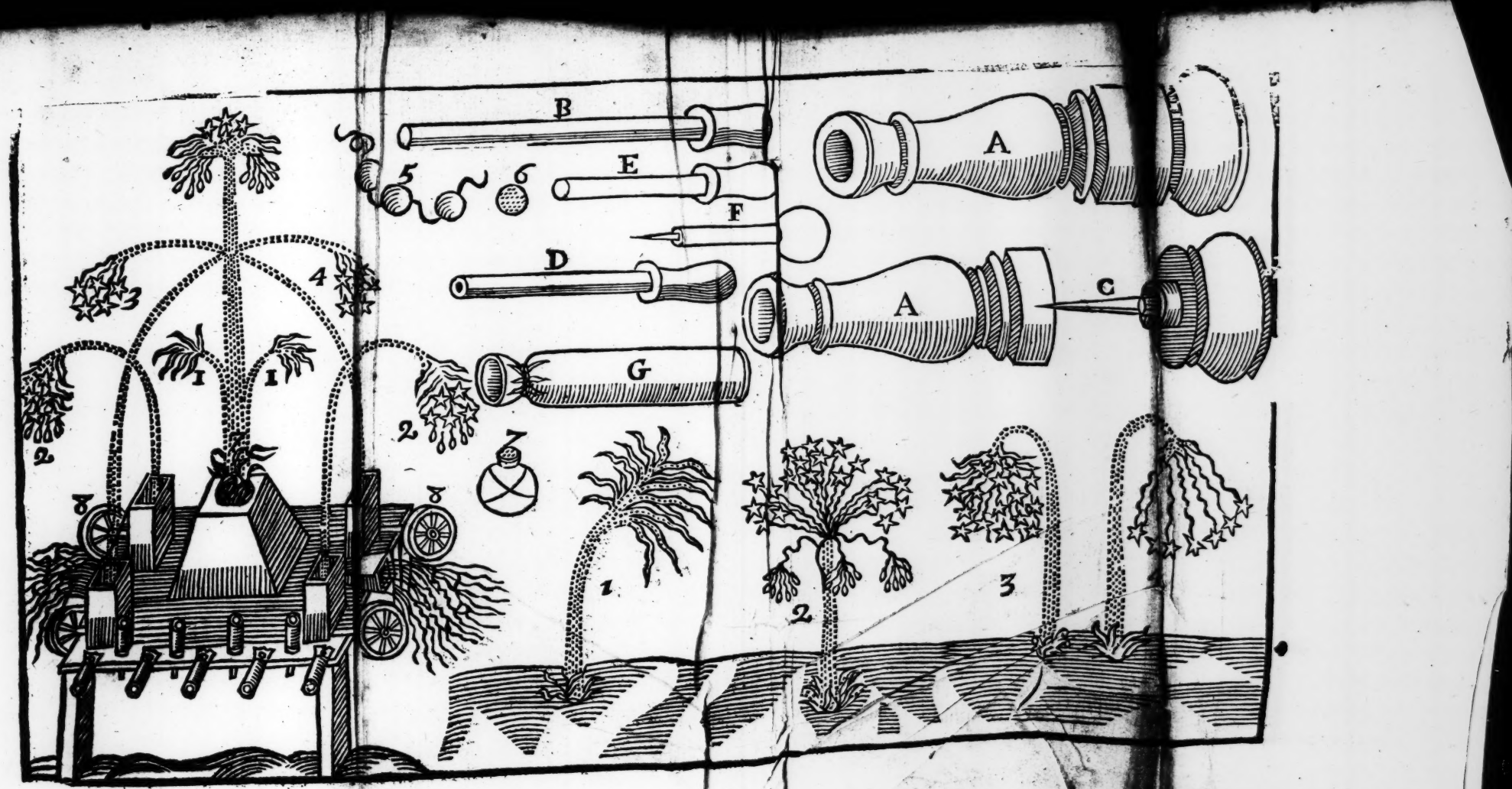
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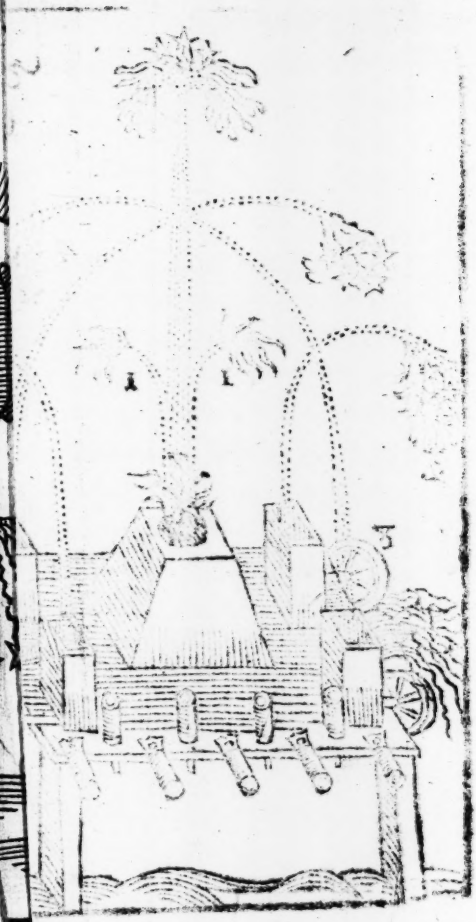

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